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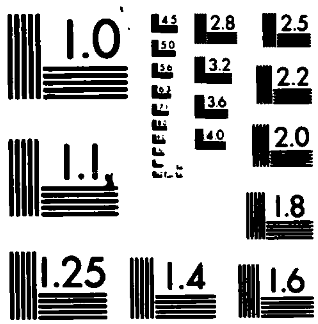

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COESAM/PDW-83/001

Black Warrior-Tombigbee Rivers, Alabama

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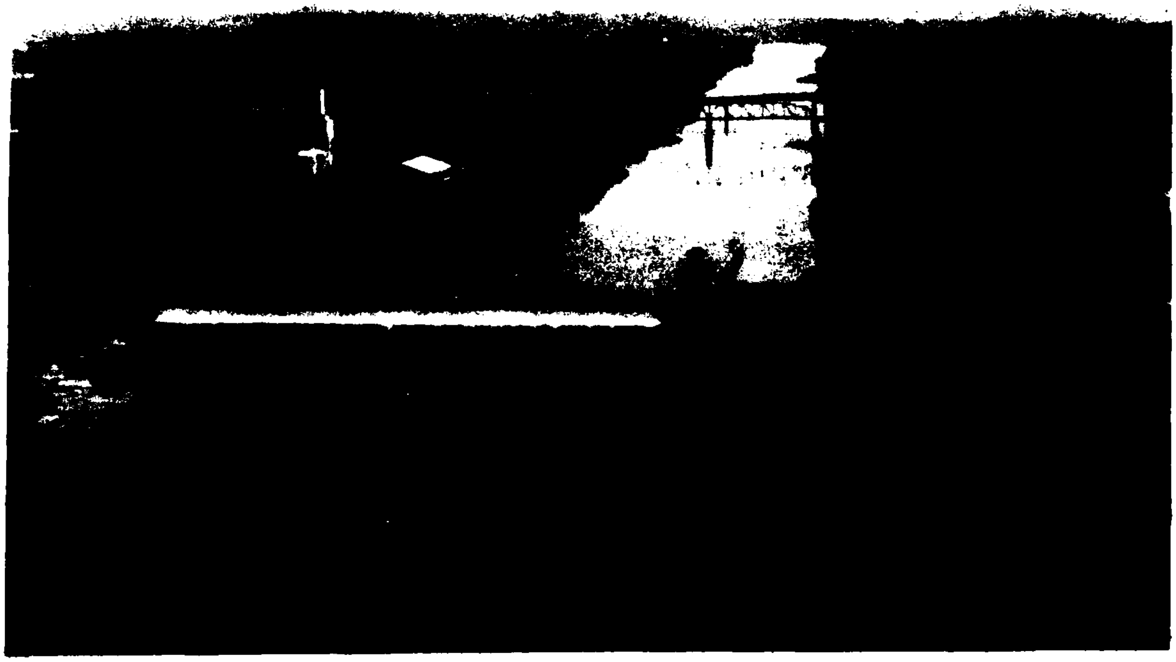

JUNE 1983

US Army Corps of Engineers
Mobile District
South Atlantic Division

A

Interim Feasibility Report and Environmental Impact Statement for Oliver Lock Replacement

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Unclassified

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REPORT DOCUMENTATION PAGE

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Hydropower was analyzed for a run-of-river plant to be added to the new dam.

The report has a main report section which is supported by appendices for Engineering, Design, and Cost; Economics; Environmental, and Pertinent Correspondence. The EIS is also contained within the volume.

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Hydropower was analyzed for a run-of-river plant to be added to the new dam.

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SADPD-P (5 Jul 83) 1st Ind
SUBJECT: Interim Feasibility Report and Environmental Impact Statement for Oliver Lock Replacement

DA, South Atlantic Division, Corps of Engineers, 510 Title Building, 30 Pryor Street, S.W., Atlanta, Georgia 30303 12 August 1983

TO: Resident Member, Board of Engineers for Rivers and Harbors, Kingman Building, Fort Belvoir, Virginia 22060

I concur in the recommendations of the District Engineer

Forrest T. Gay III
FORREST T. GAY, III
Brigadier General, USA
Commanding

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2288
MOBILE, ALABAMA 36628

REPLY TO
ATTENTION OF:
Western Basins Branch

INTERIM FEASIBILITY REPORT

AND

ENVIRONMENTAL IMPACT STATEMENT

FOR

OLIVER LOCK REPLACEMENT

Black Warrior-Tombigbee River System

June 1983

Revised December 1983

SYLLABUS

This report is an interim response to a 1950 House of Representatives resolution requesting the Black Warrior-Tombigbee river system be examined for possible modification.

Subsequent to the construction of William Bacon Oliver Lock in the late 1930's, a larger chamber size was adopted for new locks being built on the waterway. Therefore, Oliver Lock has the smallest chamber of the six locks on the waterway. Traffic through the lock has increased threefold since Oliver was opened and is predicted to nearly double in the next 20 years. The six-barge tow which is now being used cannot be accommodated in Oliver, hence a significant delay occurs since it is forced to double lock. The use of six-barge tows has caused the Oliver Lock to become incompatible with the five other locks on the waterway.

The report defines several options for solving the traffic delay problem at the Oliver project. In addition to the no action alternative, structural and nonstructural measures were considered. The most comprehensive and complete solution would be replacement with a larger lock chamber of 110 x 600 feet located at either of three different sites. Benefits to navigation were basically the same regardless of location.

The feasibility of including hydropower generation at the new Oliver Lock site was investigated in conjunction with the navigation study. It was determined that a small scale hydropower plant could be economically justified for construction concurrent with the development for lock replacement.

The multipurpose project first cost is allocated between navigation and hydropower as $101,708,000 and $21,892,000, respectively. Annual benefits are also allocated between navigation and hydropower as $35,700,000 and $2,400,000, respectively. This project plan would have a benefit-to-cost ratio of 3.1 to 1.

R/12/83

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MAIN REPORT

Introduction

This report presents the results of concurrent investigation concerning lock replacement and hydropower development for William Bacon Oliver Lock and Dam, Tuscaloosa, Alabama. This study began in 1950 with primary concern for upgrading the Black Warrior-Tombigbee Rivers and after considerable study of at site changes to increase efficiency at other locations on the waterway, attention has now focused on the William Bacon Oliver Lock.

Study Authority

The study and report are in compliance with the following resolution adopted 21 April 1950 by the Committee on Public Works of the House of Representatives:

> "Resolved by the Committee on Public Works of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the reports on the Warrior and Tombigbee Rivers, Alabama and Mississippi submitted in House Document No. 276, 76th Congress, 1st Session, and previous reports, with a view to determining whether any modification of the existing navigation project on these streams between Mobile and Birmingham, Alabama, is advisable at this time."

Purpose and Scope of Work

The purpose of this study is to thoroughly examine the need and justification for modifications to the existing William Bacon Oliver Lock and Dam, Tuscaloosa, Alabama (Oliver). Potential navigation improvements at Oliver Lock gave consideration to both Black Warrior-Tombigbee (BWT) and Tennessee-Tombigbee Waterway (TTW) traffic. However, investigation of hydropower potential was limited to production capability at existing projects on the BWT Waterway. Engineering and design considerations were of sufficient scope to establish practicality of various alternatives yet limited by minor foundation explorations and brief office studies of at site cost effectiveness.

Prior Reports

In granting authority for this study, Congress requested a review of prior reports in view of current activities on the waterway. These reports are listed in Table 1 along with specific actions authorized. The original project for slack water improvement authorized in 1887 was essentially complete by 1915 when the last project in the series of 17 locks and dams was finished. As commerce on the river increased, various modifications to the project were authorized which enlarged channel dimensions and provided for larger lock, and dams. The last such modification was the construction of the John Hollis Bankhead Lock which opened to traffic in 1975.

In addition to the reports concerning navigation, there have been reports on hydropower at various locations on the river. These reports were preliminary in scope but indicated a potential existed for hydropower at Oliver, Warrior, Dempolis and Coffeeville Locks and Dams. The Alabama Electric Cooperative (AEC) has submitted an application for a license to the Federal Energy Regulatory Commission for construction of a hydropower plant at Demopolis. AEC also had preliminary permits for hydropower development at Oliver, Warrior and Coffeeville. The Soil Conservation Service, USDA, in cooperation with the Alabama Office of State Planning and Federal Programs is conducting a statewide land and water resources cooperative

Table 1 Prior Reports

The existing project was authorized by the following:

Acts	Work Authorized	Documents and reports
5 July 1884	Original appropriation for improving Black Warrior River...	Annual Report, 1887, pt 2, p 1302.
	Original project for slack-water improvement authorized by Secretary of War, April 19, 1887.	
19 September 1890	Maintenance of the section of Tombigbee river below Lock 1 to its mouth (66 miles) includes in the existing project.	H. Doc. 178, 56th Cong., 2d sess., and Annual Report 1901, pt 3, p 1850.
	Construction of locks and dams 1, 2, and 3. Merging of the individual project for the Black Warrior and Warrior Rivers and the Tombigbee River below Demopolis.	H. Doc. 165, 57th Cong., 1st sess., and Annual Report, 1902, p 1293.
3 March 1899	Construction of the first locks between Tuscaloosa and Demopolis.	
2 March 1907	Construction of locks and dams Nos. 14; 15, 16 and 17	
3 March 1909	Provides for reconstruction of obsolete structures, modified in plan and location, to provide efficient and economical maintenance and operation.	Public Law 317
22 August 1911	Changes lift at lock 17 to 63 feet, and construction of locks and dams 18 and 19 eliminated from the project. Extension of slack-water improvements to Sanders Ferry on Mulberry Fork and Nichols Shoal on Locust Fork.	H. Doc. 72, 62d Cong., 1st sess.
2 March 1919	Raising of various dams 2 feet and raising the lock walls 2 feet at lock 1 to provide a minimum depth of 8 feet at low water, widening th channel to 150 feet where practicable.	Annual Report, 1918, p. 876.
30 August 1935	For snagging Mobile River from the mouth of Chickasaw Creek	H. Doc. 728, 71st Cong., 3d sess.
	Increase channel dimensions to 9 by 200 feet; construct crest gates at lock and dam 17; add flashboards at all dams; Sunflower Bend Cutoff.	H. Doc. 56, 73rd Cong., 1st sess., and Rivers and Harbors Committee Doc. 45, 73d Cong.

Table 1 Prior Reports (cont)

The existing project was authorized by the following:

Acts	Work Authorized	Documents and reports
	Construction of a lock and dam near Tuscaloosa to replace original locks and dams 10, 11, and 12.	Rivers and Harbors Commitee Dec. 26, 74th cong. 1st sess.
26 June 1934	Operation and care of locks and dams provided for with funds from War Department appropriations for rivers and harbors.	
Section 4 of Flood Control Act, December 22, 1944.	Recreation facilities.	
2 March 1945	Construction of a lock and dam near Demopolis to replace existing dams 4, 5, 6, and 7.	H. Doc. 276, 76th Cong., 1st sess.
	Provide increased spillway capacity at dam 1.	H. Doc. 382, 76th Cong., 1st sess.
14 July 1960	Jackson Lock and Dam, Wildlife Refuge.	H. Doc. 50, 86th Cong., 1st sess.
3 March 1909	Construction of Coffeeville Lock replacing dams 1, 2, and 3	Secretary of Army.
3 March 1909	Construction of Warrior Lock replacing dams 8 and 9	Secretary of Army.
3 March 1909	Construction of Holt Lock replacing dams 13, 14, 15, and 16	Secretary of Army.
2 March 1909	AE&D of John Hollis Bankhead Lock	Secretary of Army Ltr. 19 September 1966.
3 March 1907	Construction of John Hollis Bankhead Lock	

study which originally was to identify potential impoundment sites for municipal and industrial water supply. However, a revised plan of work published in December 1982 removed this work item since a December 1980 study was available for the Black Warrior basin and it identified general site areas and characteristics for impoundments on tributaries to the Black Warrior River.

The Mobile District, Corps of Engineers, prepared a reconnaissance report in April 1981 concerning the possibilities of providing a navigation channel to Birmingham. The report concludes that further studies at this time would not be made due to significant environmental impacts and lack of economic justification.

Study Background

1935-1970. A new lock (Oliver) was authorized in 1935 to replace the Locks 10, 11, and 12 of the original development and it was opened to traffic on 29 August 1939. Several years after completion of the structure, small cracks appeared in the concrete surfaces. A special investigation was conducted in 1947-1948 and it was found that no further study of alkali-aggregate reaction was necessary and that extensive repairs appeared impractical. Concerns expressed at the public meeting held in Tuscaloosa in the fall of 1950 indicated that other structures on the waterway required more immediate attention than Oliver and a 20-year period of modernization was launched. Construction of Demopolis and Warrior Locks began in the early 1950's with Coffeeville starting later in the decade. Holt Lock and the spillway at Bankhead were under construction during the 1960's, while Bankhead Lock was constructed during the early 1970's.

1970-1974. During the period 1970 through 1973, Mobile District made studies of the feasibility of replacing Oliver Lock. Several public meetings were held at Tuscaloosa to gather information for the study. Engineering studies consisted of site selection, preliminary design, and cost estimates for a 110- by 600-foot lock. Benefit studies utilized the then accepted procedure of evaluating the cost of delays to users of the existing lock along with a projection of future tonnage expected to utilize the

Oliver Lock. Based on the findings of the engineering and benefit studies, it appeared that replacement of Oliver Lock was feasible and economically justified. A draft report was prepared for review by South Atlantic Division (SAD), Office of the Chief of Engineers (OCE), and the Board of Engineers for Rivers and Harbors (BERH). In May of 1974 a meeting was held in Mobile with SAD, OCE, and BERH to discuss the draft report. At that time OCE and BERH representatives recommended that benefits be based on a systems analysis of the BWT Waterway rather than the cost of delays at single lock. This change in benefit methodology was being implemented by OCE because the Assistant Secretary of the Army for Civil Works (ASACW) was requiring that benefits be analyzed on a system rather than individual project basis. This requirement came out of the ASACW review of the Gallipolis Lock Replacement Report in 1973. A decision in Federal Court in 1974 concerning replacement of Locks and Dam No. 26 on the Mississippi River further strengthened the requirement that project benefits must be based on a system analysis. Mobile District delayed finalizing the Oliver Lock replacement report until a system benefit analysis could be performed. Because the systems analysis required additional data collection, the report was rescheduled for the end of 1975.

1975. In February 1975, the Mobile District began a study to update the economics for the Tennessee-Tombigbee Waterway (TTW) project. A part of this study was a new benefit study which was contracted to A. T. Kearney Management Consultants. When Kearney analyzed the data collected from a current traffic survey, they found that much of the potential traffic identified was through traffic to and from the Port of Mobile. Since the TTW joins the BWT at Demopolis, the BWT would have to carry its own traffic plus the traffic from the TTW between Demopolis and Mobile. The Mobile District had not gathered the data necessary for the system analysis at that time, so an estimate of waterway and lock capacity was made by a consultant to OCE based on many judgmental factors such as average tow speed, average delay at locks, and average tons per tow. This estimate indicated that the capacity of the BWT downstream from Demopolis would be about 44 million tons annually. The BWT share of the capacity was estimated to be about 15 million tons. In November 1975, OCE decided that

Mobile District should undertake a study of the lower BWT to determine the feasibility of increasing the channel width to 300 feet. This width would be compatible with the TTW, would provide for 8-barge tows and two-way traffic, and would increase the capacity of the lower BWT beyond the 44 million tons. At that time, the analyses showed that the replacement of Oliver Lock would not be economically justified until a solution was developed for the lower BWT capacity constraint.

1976-1977. Mobile District initiated the study of possible improvements to the lower BWT. The study was scheduled for completion in October 1977. During early 1976 Mobile District again investigated the structural integrity of Oliver Lock and found it was structurally sound and had a long life expectancy. Therefore, safety or structural decay could not be used as justification for replacement before the study of the lower BWT, including a systems analysis, was completed. Late in 1976, L&N Railroad and others filed suit againist the TTW, and many of the allegations related to the relationship between the TTW and the BWT. Mobile District stopped work on the BWT study while responses were prepared to the allegations. Late in 1977 the BWT study was resumed, and a revised date of January 1979 was established for report completion.

1978-1979. As a result of SAD an OCE requirements to comply with the Principles and Standards for Water Resource Planning an Environmental Quality Committee of interests outside the Corps of Engineers was formed early in 1978. This committee identified the need for additional studies that had not been scoped or budgeted. Mobile District determined that funds were not available for all of the studies needed to complete the report. Available funds were used to accomplish environmental studies in 1978 and 1979, and additional funds were requested in the Fiscal Year 1980 budget to continue work on the overall study.

1980. Funds were provided in Fiscal Year 1980 to continue the engineering studies for widening the lower BWT and for completion of the environmental studies initiated in 1978 and 1979. A new schedule was developed

that called for study completion in September 1983. The report was to include consideration of the feasibility of widening the lower BWT to 300 feet. The Waterways Experiment Station's (WES) methodology as used for evaluation of Gallipolis and Locks and Dam No. 26 was selected for analysis of the BWT. Therefore, WES was funded to assist in developing the system model for the BWT. In September 1980, representatives of Mobile District, SAD, and OCE met with members of the Alabama Congressional delegation and members of the Warrior-Tombigbee Association to discuss the status of the BWT studies. At the conclusion of the meeting, the Corps was asked to prepare an interim report on the replacement for Oliver Lock.

1981-1982. The Mobile District made economic, enviromental and engineering studies which would lead to a draft interim report on Oliver Lock replacement in January 1982. OCE and SAD were provided an internal review draft in December 1981. Their conclusion was that Mobile District had not adequately supported the benefits for Oliver Lock replacement and that the benefits could not be adequately supported until the system analysis was complete. Therefore, detailed studies were continued until a systems analysis was completed. This report is in compliance with instructions pertaining to economic evaluation of project benefits through use of the systems analyses methodology.

Plan Formulation

Natural Resources and Environmental Setting

The Black Warrior River is formed by the junction of the Locust and Mulberry Forks approximately 20 miles west of Birmingham, Alabama, and flows southwestward 45 river miles to Tuscaloosa, Alabama, and thence southward 120 river miles to its confluence with the Tombigbee River at Demopolis, Alabama. From its head above the John Hollis Bankhead Lock and Dam, the Black Warrior River falls 182 feet in 4 pools to Demopolis 216 miles above Mobile. From Demopolis, the Tombigbee falls an additional 76 feet in 2 pools, providing a total lift of 258 feet over a waterway distance of 380 river miles from its point of origin to its confluence with the Alabama River some 45 miles north of Mobile (see Figure 1).

The Black Warrior River basin lies at the southern end of the Appalachian Mountain Range within three distinct physiographic regions and land forms. The northern part of the basin is situated in the Cumberland Plateau, a subdivision of the Appalachian Plateau physiographic province, while the southern part of the basin occurs in the East Gulf Coactal Plain sector of the Gulf Coastal Plain Province. The Cumberland Plateau of rough and mountainous terrain contains deposits of coal, iron ore, and limestone, which are used in the making of steel products by extensive industrial development in the Birmingham area and then transported down the Black Warrior-Tombigbee River Waterway to the Port of Mobile. Large quantities of coal are also shipped for electric power plants and export. Total estimated coal resources for the State of Alabama, including identified resources and hypothetical resources (estimated in unmapped and unexplored areas), is approximately 41 billion tons. It is estimated that 24 million tons of coal were mined in Alabama in 1979. Separating the Coastal Plain from the Appalachian Plateau is the Fall Line. The Fall Line Hills, attaining a maximum width of 50 miles in western Alabama, occupy a zone of transition where falls and rapids develop in streams as they descend from Palezoic rocks to the less resistant sandstones and clays of the Coastal Plain.

Oliver Lock and Dam is located slightly downstream of the point where the Black Warrior River leaves the rocks of the Cumberland Plateau and begins to flow over Coastal Plain sediments. In the vicinity of Oliver Pool the river valley changes from the typical mature erosional stage to a broad valley with numerous stream meanders characteristic of an older stage of development.

Oliver Lock and Dam is 346.3 river miles above Mobile, Alabama, in Tuscaloosa County within the corporate limits of the city of Tuscaloosa. The Oliver Pool has an area of 790 acres, a length of 8.8 miles, and a storage volume of 12,400 acre-feet at normal pool elevation 123. The main tributaries entering the Oliver Pool are Hurricane Creek and North River. Figure 2 shows the Oliver Pool and immediate features.

Water quality of Oliver Pool has historically been extremely poor. However, recent changes in the industry in the Tuscaloosa area combined with stricter water quality standards have worked to alleviate the water quality problems. The Water Quality Management Study of the Middle Black Warrior River (1980) indicated that no excessive pollution was adversely affecting water quality in the area. Analyses of water samples from the Oliver Pool found that pollutants were within tolerable limits.

The average annual temperature of the area is 62 degrees F. The normal monthly temperature ranges from about 46 degrees F in January to about 82 degrees F in July. A minimum of -17 degrees F and a maximum of 110 degrees F have been recorded in the area. The normal frost-free period of seven months lasts from April to October.

The prevailing winds are from the north in the fall and winter, and from the south in the spring and summer. March is the windiest month with an average speed of 8.5 mph, while October has the least wind with an average speed of 4.4 mph. The average wind speed for the year is 6.5 mph.

Available information on air pollutants monitored in Tuscaloosa County indicate that the national primary air quality standards for particulate matter and sulfur dioxide are currently being met.

Tuscaloosa County has a total area of 857,600 acres. The land use breakdown of the County in 1975 is given in Table 2. Cotton, corn, hay, and cattles are the main agricultural enterprises in the county. Industrial development has taken place on the left bank above the city of Tuscaloosa and below Oliver Lock and Dam.

The distribution of plants and animals in the Black Warior River basin is affected by the natural geological phenomenon designated as the Fall Line. Vegetatively, the project area is located within the transition between the southern flood plain forest and the more northern oak-hickory-pine forest. The southern flood plain forest types are concentrated in the

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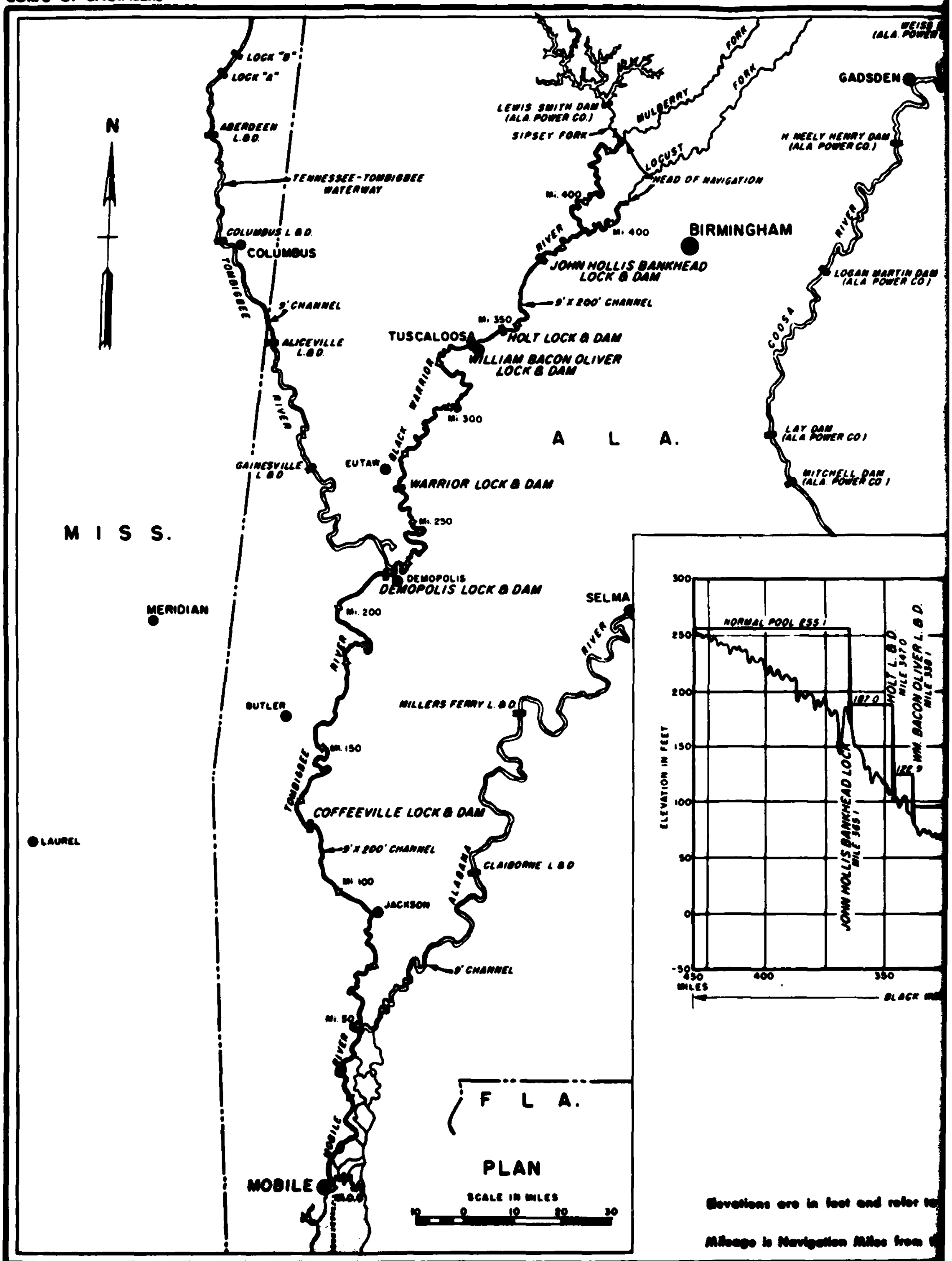

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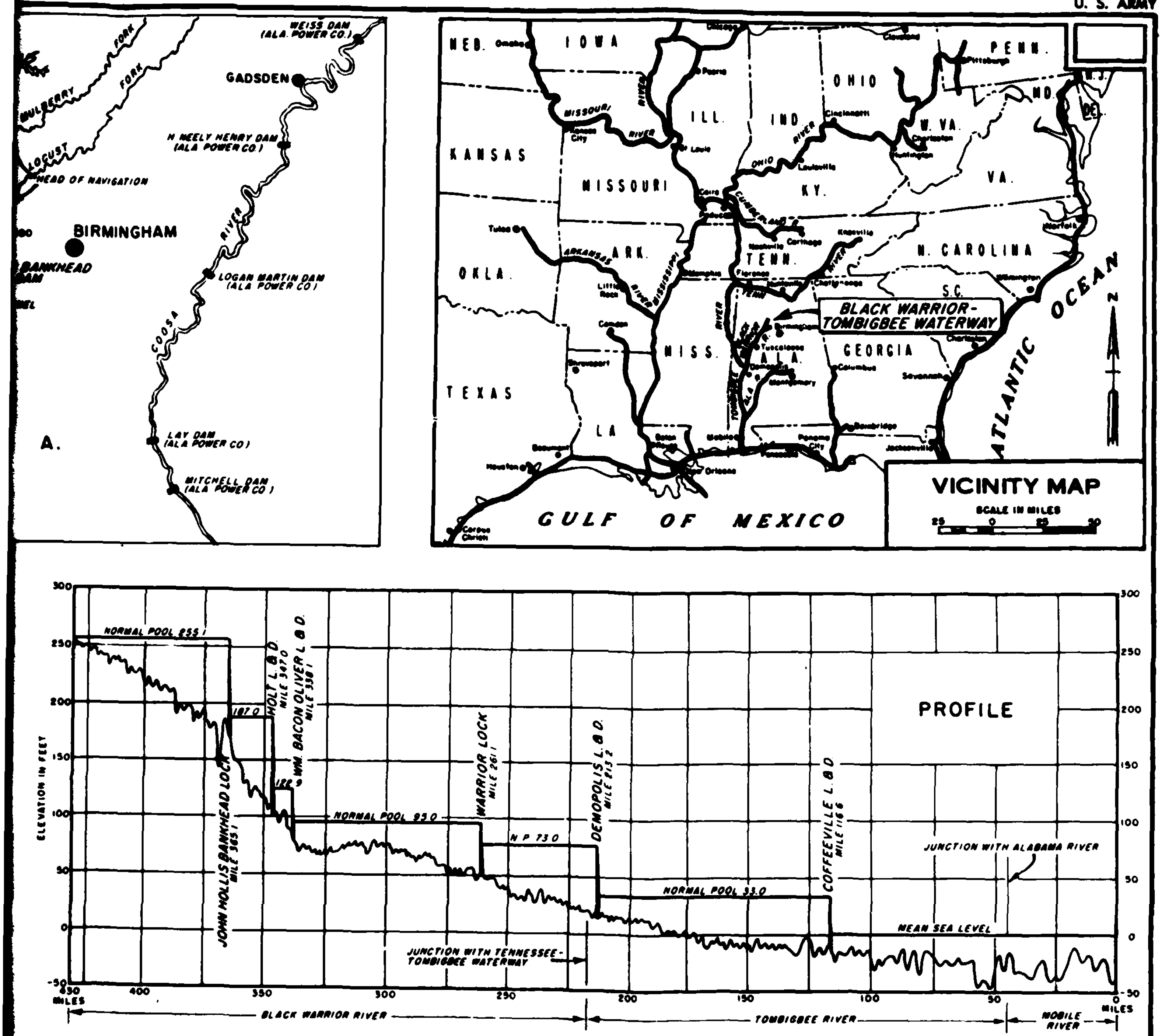

BLACK WARRIOR & TOMBIGBEE RIVERS, ALABAMA

REVISED TO 30 SEPTEMBER 1978

OFFICE OF THE DISTRICT ENGINEER
MOBILE, ALABAMA

Elevations are in feet and refer to National Geodetic Datum.

Mileage is Navigation Miles from the foot of Government Street, Mobile, Alabama.

Figure 1

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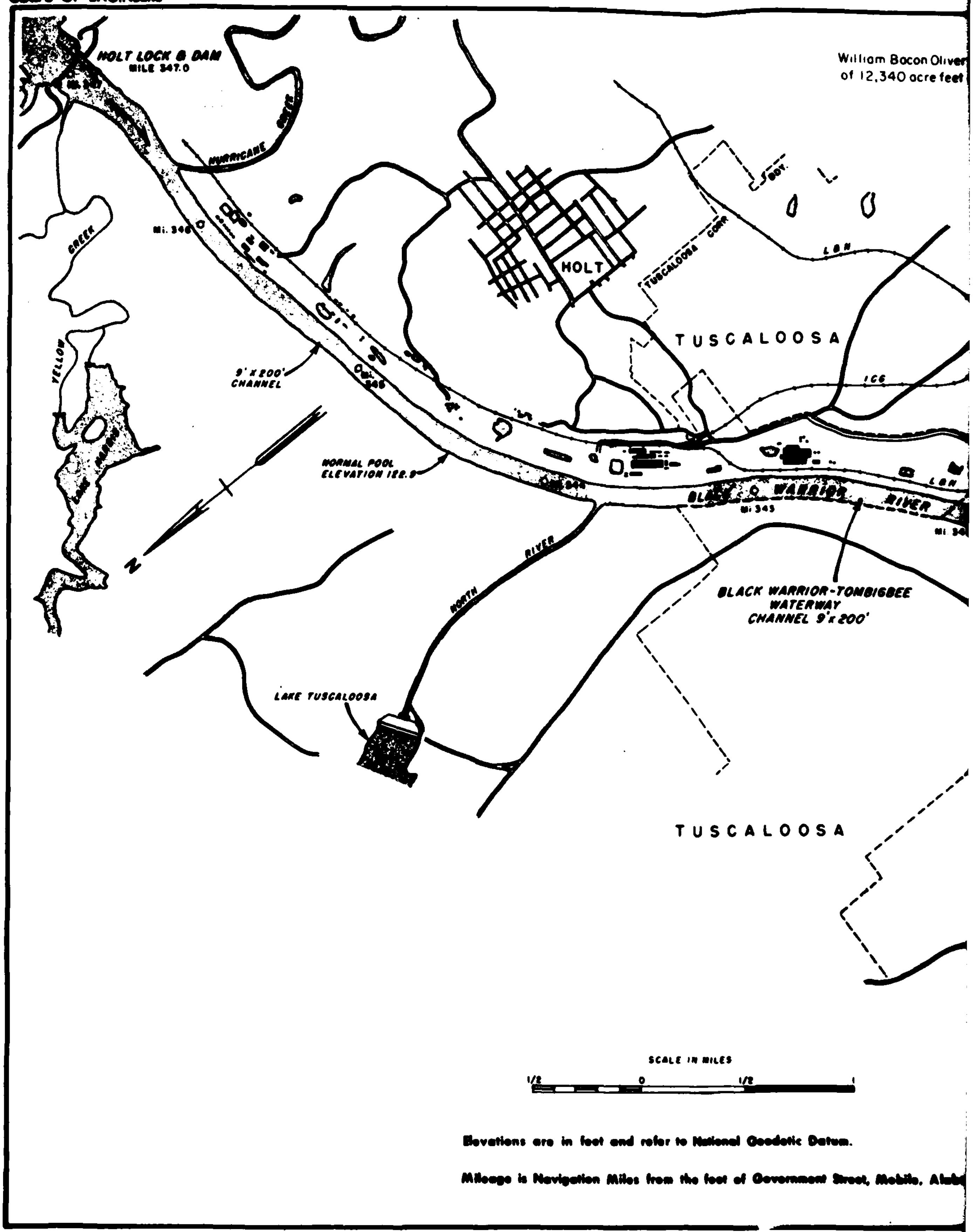

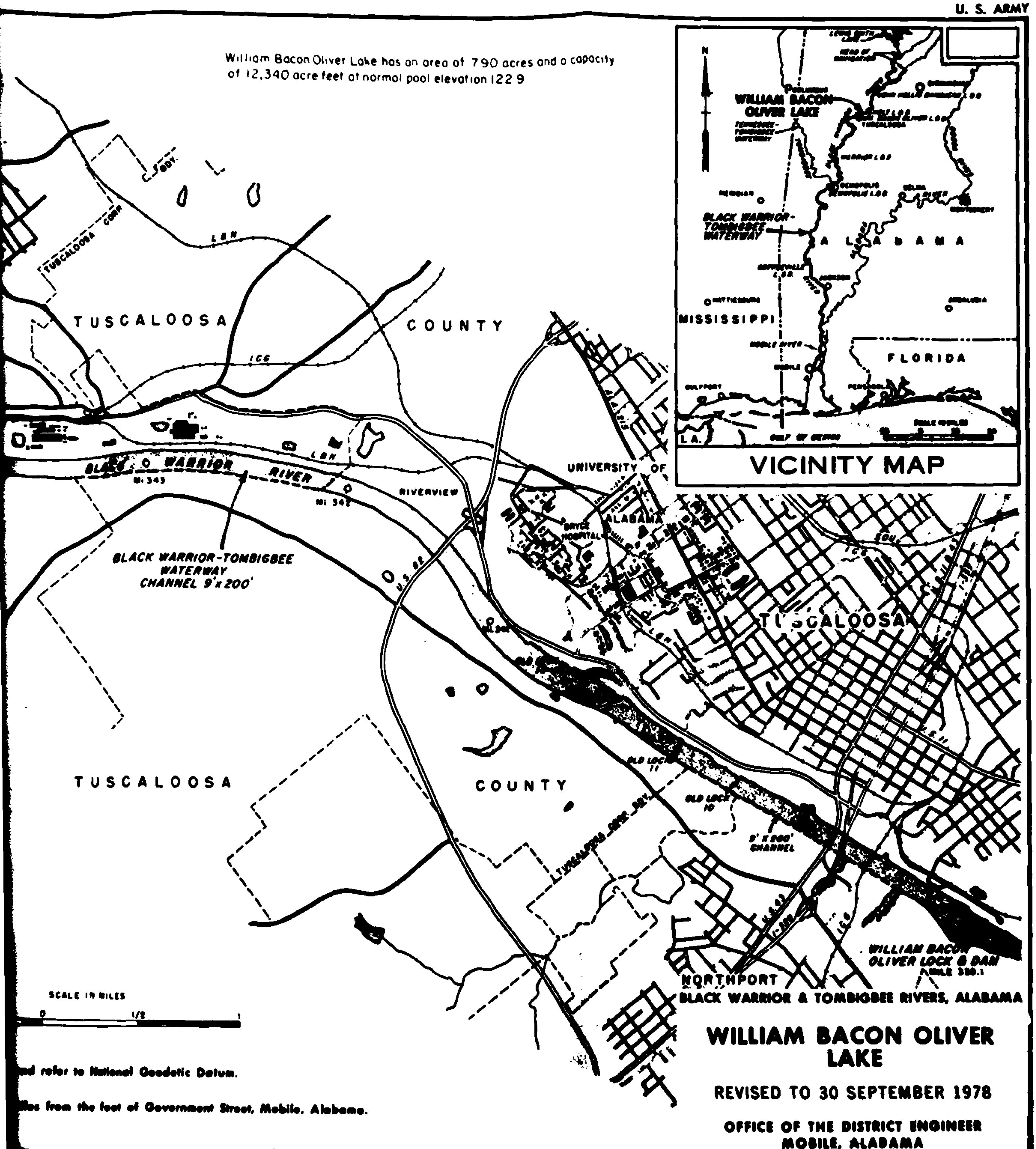
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COUNTY
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BRYCE HOSPITAL
BLACK WARRIOR-TOMBIGBEE WATERWAY CHANNEL 9'x 200'
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TUSCALOOSA
OLD LOCK 11
OLD LOCK 10
9' x 200' CHANNEL
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WILLIAM BACON OLIVER LAKE
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MISSISSIPPI
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BLACK WARRIOR & TOMBIGBEE RIVERS, ALABAMA
WILLIAM BACON OLIVER LAKE
REVISED TO 30 SEPTEMBER 1978
OFFICE OF THE DISTRICT ENGINEER
MOBILE, ALABAMA
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les from the foot of Government Street, Mobile, Alabama.

Figure 2

1 2

swamp areas and flood plain along the Black Warrior River. The oak-hickory-pine forest types are located on the higher, drier areas of the basin. Significant stands of marketable timber are absent.

Table 2

Tuscaloosa County Land Use (1975)
(Acres)

Residential	10,800
Commercial	800
Public/Semi-Public	14,800
Industrial	1,800
Transportation and Utilities	17,000
Agriculture	100,000
Forest Land	681,000
Extractive	18,400
Vacant Land and Water	13,000
	857,600

Small populations of the southern gray squirrel, cottontail rabbit, and opossum occur in the project area. Smaller mammals are present in the open disturbed areas.

The bird population of the Black Warrior-Tombigbee River system is both extensive and varied. This includes birds which utilize habitats such as the impounded waters, shallow waters, mud flats, and sandbars. Some 100 or more bird species inhabit the basin. It is highly probable that many of these birds rarely occur in the project area or are only transient members of the bird population in the vicinity of the present dam.

Turtles, lizards, and snakes comprise the bulk of the reptilian fauna in the project area. Water snakes, cottonmouths, and copperhead are the major snakes found in or around the water. Salamanders, frogs, and toads comprise the amphibian population along the river.

The wildlife habitat found in the project area is limited by the close proximity of human activities (the city of Tuscaloosa on the left bank of

the Black Warrior River and the city of Northport on the right bank) as shown on Figure 2.

According to William F. Smith-Vaniz's Freshwater Fishes of Alabama, 110 species of freshwater fishes are known to occur in the Mobile Bay drainage system with nine other species probably being found in the system based on regional distribution and/or known habitat requirements of these species. Some 18 species, although generally classified as sport species, have commercial value, and 12 forage fishes are adapted to the impoundments of the reservoirs.

Recreational use in man-days is given in Table 3 for Oliver, Holt, and Warrior projects. The low recreational usage at Oliver is due to the scarcity of public facilities and access, as well as the small size of the lake (790 acres) compared to the Holt and Warrior projects with 3,300 acres and 7,800 acres, respectively.

Table 3

Recreational use in man-days of the Holt, Oliver, and Warrior Projects for 1980

Facility Type	Holt	Oliver	Warrior
C of E	346,292	46,383	269,118
Private	2,442	24,401	579,137
Others	18,639	0	0
Total	367,373	70,784	848,255
Use			
Boat	83,464	3,846	315,683
Fish	124,062	37,129	471,021
Hunt	491	0	205,154
Picnic	61,994	3,346	379,199
Sightsee	171,768	25,564	332,956
Ski	27,242	154	115,560
Swim	72,915	4,656	0
Camp	7,697	274	78,121

SOURCE: Monthly Visitation Report, Operations Division, Corps of Engineers, Mobile.

The species composition and diversity of the molluscan fauna presently inhabiting the streams of the Black Warrior-Tombigbee drainage systems is not known with certainty, although 48 species of the native mussels (Pelecypoda) and 15 species of snails (Gastropoda) have been noted in the past as inhabitants of the overall system. Some 12 species of crayfish (Crustacea) have been reported in the drainage system.

Hydrology. The average normal annual rainfall of 53.79 inches is usually well distributed throughout the year. The wettest year of record is 1929 with an average rainfall of 81.41 inches over the basin and the driest year occurred in 1904 with an average of 41.60 inches. Basin runoff averages 22.31 inches or about 41 percent of the average rainfall. Mean unit flows average about 1.64 cubic feet per second (c.f.s.) per square mile. The mean discharge just above the Oliver L&D at the Northport gage is 7,931 c.f.s. for 59 years of record with a drainage area of 4,828 square miles. Extreme discharges for the period of record range from a maximum of 272,000 cfs on 13 April 1979 to a minimum of 37 cfs on 23 October 1953. Additional data on availability of water for hydropower and navigation are given in the Engineering, Design, and Cost Appendix.

BWT Socioeconomic Profile

The study area of the Black Warrior-Tombigbee Rivers encompasses 12 counties in Alabama; Baldwin, Choctaw, Clarke, Greene, Hale, Jefferson, Marengo, Mobile, Sumter, Tuscaloosa, Walker, and Washington. The population of these 12 counties was 1,450,091 in 1980, an increase of 11.5 percent over 1960. In these 12 counties, there is a significant variation in population size, growth rate, and population density. Greene County had the lowest number of residents in 1980, 11,021 persons, while Jefferson County, comprising the major portion of the Birmingham SMSA, had 671,197 individuals. Density, i.e., number of persons per square miles, ranged in 1980 from 16 in Washington County to 602 in Jefferson County. Five of the 12 counties lost residents between 1960 and 1980. Jefferson County grew by only 5.7 percent, while the population in Baldwin County, part of the

Mobile SMSA, increased by 59.8 percent. Hale County shows a total loss of 20 percent from 1960 to 1980; yet more than 90 percent of that loss occurred during the 1960's. During the decade of the 1970's, the population of Hale County began to increase slightly.

Based on a survey conducted in 1975 by the National Cancer Institute, females predominate, comprising 52 percent of the total population of the study area. One interpretation of the age groupings indicates that persons between the ages of 20 and 35 steadily leave the area. The figures show a decrease of approximately 20,000 persons for every 5-year increment between the ages of 10 and 35. Thereafter, the decrease slows until the 40-44 years of age category at which point an actual increase occurs. As the age grouping of the labor force normally ranges from 18 to 65, sharp decreases in numbers of people within the range usually mean a severe lack of economic opportunities to keep potential income earners in the area. Using 1980 data. the percentage of black persons was 31.7, the same percentage for the 1970 Census count.

According to figures from the 1970 Population Census, approximately 30 percent of the persons living in the study area were enrolled in some type or level of school. Specifically, 17 percent were in primary schools; 8 percent in high schools; and 4.2 percent in colleges and universities.

The number of housing units increased during the period of 1970 to 1980 in those counties showing the largest growth in population. Following trends reported nationally, the most significant increases in the number of housing units in 1980 were found in those portions of SMSA's outside of the central cities.

Four of the 12 counties contain sizable acreages of agricultural land; Hale, Greene, Sumter, and Marengo. Land use in the remaining eight counties is less than 21 percent agricultural and more than 50 percent forest. Forested land comprises at least two-thirds of the land area in 10 of the 12 counties. The two exceptions are the Gulf Coast counties of Baldwin and Mobile, both of which encompass extensive acreages of water and wetlands.

Jefferson and Mobile Counties show the highest percentages of urban and built-up land usage. While much of that usage is within the central, urban centers of Birmingham and Mobile, the heavier concentration of industrial build-up is in suburban areas.

Based on county business patterns in 1979, economic activity within the study area was healthy. Employment increased in seven of the eight major industrial categories during the period 1976 to 1979. The only exception was manufacturing, which showed a 2.9 percent decrease in the work force. Mining concerns showed the largest percentage of expansion in employment, an increase of 50.4 percent from 1976 to 1979. Manufacturing remained the dominant work force during the three-year period, despite the decline in employment. Services replaced Retail Trade as the second most important sector of employment. Agricultural activities slipped from ninth to tenth place, reflecting a regional trend of the decline of farm, forestry, and fishing as sources of livelihood. In 11 of the 12 counties, the labor force was increased by varying amounts between 1975 and 1980. Only in Sumter County did the number of potential income earners decrease while the rate of unemployment increased to almost double what it was.

Income generated within the 12-county area increased 62 percent between 1970 and 1975. Part of the increment is due to inflation, part to the increased activity in the industrial sectors of mining and contract construction. The farming sector generated more than a 10 percent increase in income, despite the reduction in the size of the farming work force. The most impressive gains were recorded for mining (170 percent) and construction (111 percent). Neither sector was the dominant source of income; rather, manufacturing remained the most important income-producing industry, despite the relatively low expansion rate of 37 percent. The urbanized counties of Jefferson, Mobile, Tuscaloosa, Walker, and Baldwin ranked highest in levels of income from mining and construction. Income earners in Greene County remained the poorest, followed by residents in Hale, Sumter, and Washington Counties.

The growing importance of mining within the study area is evidenced by the increases in employment and income generated by this single industrial

sector. During Fiscal Year 1980, mining concerns throughout Alabama employed 14,950 persons and produced nearly 26 million tons of coal. Mineral production yielded more than 36 million tons. Major minerals, excluding coal, mined in the study area are limestone, dolomite, blast furnace slag, clay, clay and sand, and sand and gravel. Active mining of these minerals is scattered throughout the study area, encompassing 10 of the 12 counties along the Black Warrior-Tombigbee Rivers. By contrast, coal mining, both strip and underground, is concentrated in Jefferson, Walker and Tuscaloosa Counties. Coal production in the study area totaled more than 18 million tons, or almost 70 percent of the production for the entire state. During 1976, 11,633 individuals were employed in mining activities throughout the state, of which 8,480, or 73 percent, resided in the counties along the Black Warrior-Tombigbee Rivers.

Transportation

Transportation infrastructure in the study area consists of highways, railroads, airports, and pipelines. Highways serving Tuscaloosa are: Interstates 20 and 59; US routes 82, 11, and 43; and State Route 216. I-359 which will connect the downtown area to I-59 is now under construction and plans for extending River Road to the west under the ICG railroad bridge to 32nd Avenue are being developed. There are two major highways crossing the river just above Oliver Lock. The Lurleen Wallace Bridge located about 4,300 feet upstream and MacFarland Avenue located 4.3 miles upstream. Three freight hauling railroads pass through Tuscaloosa: Southern, L and N, and ICG. AMTRAC provides passenger service to New Orleans and Atlanta daily. The ICG railroad bridge also crosses the river in the Oliver Pool about 2,800 feet upstream from the lock. The Tuscaloosa Airport has service from the Republic Airlines and South Eastern Airlines. Three major pipelines owned by Plantation, Colonial, and Southern Natural Gas serve the area but do not obstruct navigation. One company, Hunt Oil, has a pipeline carrying crude to its riverside refinery.

The waterways of Alabama are among the most reliable in the Nation. In addition to the BWT which connects Port Birminham with Mobile, the Alabama

River provides navigation to Montgomery from Mobile, and the Tennessee-Tombigbee Waterway (TTW) is open to Columbus, Mississippi. All three of these waterways share the 45 miles of the Mobile River and the TTW shares 170 miles of the lower Tombigbee River with the BWT. Tonnage carried on these waterways in 1981 was 15,962,211 tons on the BWT, 2,159,397 tons on the Alabama Coosa, and 102,345 tons below the Gainesville Lock on the TTWW. The largest portion of this tonnage consist of coal and iron ore which are low value, high bulk commodities.

Electric Generating Resources

The Southeastern Electric Reliability Council (SERC) power planning region is one of nine regional groups of bulk power suppliers. The boundaries of these 9 regions are shown on Figure 3. The SERC region includes all of the States of Alabama, Georgia, Florida, North Carolina, South Carolina, and Tennessee, and parts of Mississippi, Kentucky, and Virginia. This council is divided into four subregions as shown on Figure 4: VACAR (Virginia-Carolina), TVA (Tennessee Valley Authority), Southern (basically the four Southern Companies), and Florida. Oliver Lock and Dam is located in the southern subregion. SERC was formed on 24 January 1970 to augment further the reliability and adequacy of bulk power supplies in areas served by member systems. Membership, which is open to all power utilities in the region, consists primarily of investor-owned and municipal utilities, but includes participation by locally owned cooperatives, Federal agencies, and State and county operated utilities. The SERC region represents about 10 percent of the nation's contiguous area but accounts for about 20 percent of the total national production of electric energy. Membership in the Southern subregion of SERC is as follows:

Alabama Electric Cooperative, Inc.
Alabama Power Company
Crisp County Power Commission
Georgia Power Company
Gulf Power Company
Mississippi Power Company
Savannah Electric and Power Company
Southeastern Power Administration
South Mississippi Electric Power Association
Southern Electric Generation Company

About 93 percent of the Southern subregion's electric generation during 1978 came from systems fueled by energies other than oil. A total of 11.5 million barrels of oil were used for electric generation in 1978. A total of 33 mcf of natural gas and 32 million tons of coal were also burned during that year for production of electricity.

Load Growth in the Southern Subregion increased at an average annual rate of about 9.0 percent between 1968 and 1972 and at a rate of about 4.5 percent between 1972 and 1977. This rate continued to decrease during the 1977 to 1979 period. The average annual growth rate of electric energy use in the Southern Subregion covering 1977 through 1979 was 3.0 percent. The summer peak demand indicates a growth rate of 3.3 percent while the winter peak demand has not shown any consistent growth. This slower growth rate will enable the Southern Subregion to maintain its favorable fuel mix position in the future with just incremental generation additions since it is not in an all out fuel conversion posture.

The Southern Subregion attempts to maintain planned generation reserve of between 17 and 20 percent of the annual peak demand. Their operating criteria requires that reserve equal to 1.5 times the largest generating unit in service be maintained at all times. At least 50 percent of this amount must be spinning. The largest generating unit in the Southern Subregion is currently about 880 MW. Planned reserve fell below 17 percent of monthly peak demand during five of the nine summer peak periods between 1977 and 1979. The lowest planned reserve as a percent of monthly peak was 8.0 percent and occurred in July 1977. The smallest actual reserve percentage was 5.9 percent and occurred in June 1977. Actual reserve exceeded the operating reserve requirement of 1,320 MW during all but one of the peak periods examined.

Future Without Project Conditions

Economics of Waterway Traffic - The economic tributary area of the Black Warrior-Tombigbee (BWT) Waterway is fairly broad. The primary area consists of the portions of Alabama readily accessible to navigable waterways. The secondary area consists of those areas in Florida, Mississippi,

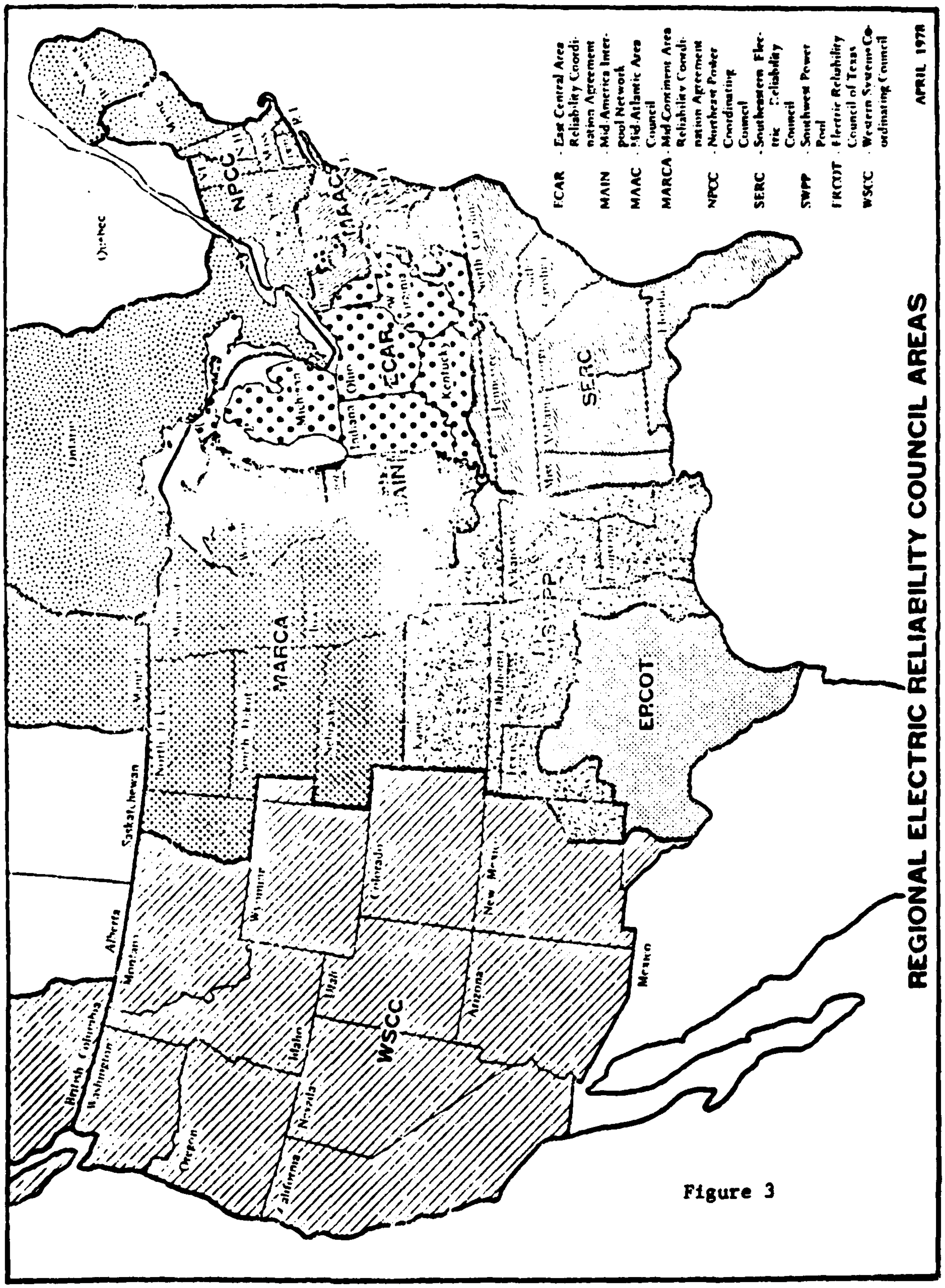
REGIONAL ELECTRIC RELIABILITY COUNCIL AREAS
ECAR - East Central Area Reliability Coordination Agreement
MAIN - Mid America Interpool Network
MAAC - Mid-Atlantic Area Council
MARCA - Mid-Continent Area Reliability Coordination Agreement
NPCC - Northeast Power Coordinating Council
SERC - Southeastern Electric Reliability Council
SWPP - Southwest Power Pool
ERCOT - Electric Reliability Council of Texas
WSCC - Western Systems Coordinating Council
APRIL 1978
WSCC
MARCA
ERCOT
SERC
ECAR
NPCC
MAAC
SWPP
MAIN

Figure 3

SUBREGION BOUNDARIES OF THE
SOUTHEASTERN ELECTRIC RELIABILITY COUNCIL (SERC)

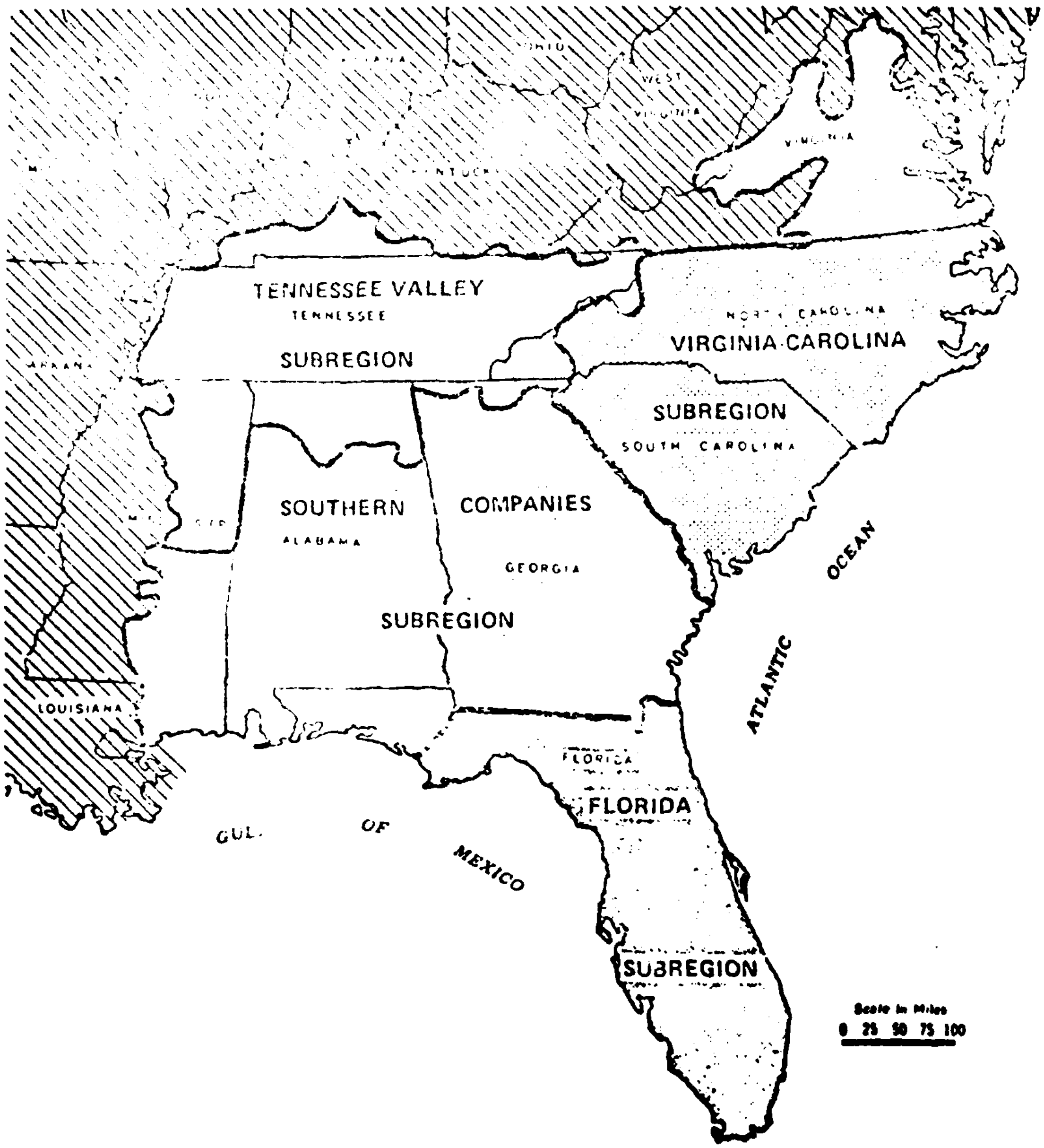

Figure 4

Louisiana, and Texas adjacent to navigable waters. Tertiary area includes all areas readily accessible to the inland waterway system. With the opening of the TTW in FY 1985 a valuable new limb will be provided between the BWT and the inland waterway system of mid America.

The base year for purposes of benefit studies is 1979. Traffic data for this year was derived from a combination of sources. The primary source for data was the 1979 point-to-point Waterborne Commerce Statistics movements collected annually under the direction of the Office of the Chief of Engineers (OCE). This data was verified and supplemented through use of Performance Monitoring System data collected at each lock under the direction of OCE and through field and telephone interviews with shippers/receivers. The types of data solicited from firms included identification and use of commodities; origin and destination points; present means of routing of transportation; volume and frequency of shipments; scheduling requirements; present transportation rates or changes; and the firm's interest in shipping on the BWT Waterway.

A list of potential waterway shippers and receivers was compiled using Waterborne Commerce Statistics dock listings, state industrial directories, Chamber of Commerce lists and other membership lists. The procedures used to verify and supplement the 1979 traffic base involved contacting shippers and receivers who are currently utilizing the BWT project. In addition, shippers and receivers with movements which have characteristics conducive to water transport were also identified and contacted. These firms were selected based on such factors as location, size of firm (in terms of employment), type of business (manufacturing or processing) and adaptability of firms raw and/or final products to water transport. A total of approximately 100 existing and potential shippers/receivers were contacted during the field survey.

For purposes of this study, the movements identified as receiving savings from utilization of the TTW, were used in the economic analysis. The rates used for these 121 movements reflect the original rates updated to 1 October 1982 price levels.

It was found during field interviews that the proposed improvement at Oliver alone would not induce modal division of [illegible] the study area currently using other modes for all [illegible] would continue to move that way even with rep[illegible] [illegible]fore, the 1979 Waterborne Commerce Statistics [illegible] as supplemented in field interviews were utilized for [illegible] analysis. Table 4 presents the base year BW[illegible] [illegible] Lock study.

The BWT movements identified through the above [illegible] [illegible] to a rate analysis. For this purpose a contractor [illegible] obtain rates for the current barge movement as well as the least cost alternative routing. Rate analysis included consideration of [illegible] loading/unloading, overland movements to and from ports, [illegible] and linehaul.

Both barge and overland rates were obtained from three primary sources: shipper/receiver quoted rates; published rates and contract and private carrier quotations. Transloading charges such as wharfage, handling, stevedoring and other accessorial charges were estimated on the basis of current charges at ports.

Rates for barge movement on waterways in other Districts potentially impacted by the Oliver Lock replacement were obtained from the latest available rate analyses for these movements performed by Districts within the Ohio River Division and the Lower Mississippi Valley Division. These rates were also based on the existing water route and the least cost alternative.

In the case of TTW the projections contained in the 1976 Ecomomic Reanalysis study were utilized for purposes of the Oliver economic analysis. All other movements were projected based on the applicable 1980 OBERS BEA growth rate considering the type of commodity, its use, and the origin and destination of the movement.

TABLE 4

Existing BWT Traffic

#	Commodity	Internal Tonnage 1/ Inbound 2/	Internal Tonnage 1/ Outbound 3/	Internal Tonnage 1/ Upbound 4/	Internal Tonnage 1/ Downbound 5/	Through 6/ Upbound	Through 6/ Downbound	Total
1	Farm Products	0	90,671	0	0	0	130,281	220,952
2	Forest Products	0	0	0	0	0	0	0
3	Fish & Marine Products	305,769	0	0	0	0	0	305,269
4	Metallic Minerals	3,098,436	41,736	0	0	0	0	3,140,172
5	Coal	218,407	3,933,245	19,734	2,870,489	0	2,585	7,044,460
6	Non-Metallic Minerals	136,147	668,369	0	0	0	0	804,516
7	Food & Food Products	4,005	0	0	0	0	0	4,005
8	Pulp, Paper & Paper Products	15,285	150,660	10,835	62,785	0	255,652	495,217
9	Chemicals & Chemical Products	225,340	200,790	7,460	2,400	56,403	0	492,393
10	Petroleum Products	207,000	314,431	2,000	36,587	21,653	0	581,671
11	S.C.G.C	194,723	48,543	0	0	0	913,256	1,156,522
12	Primary Metals	51,328	231,610	0	0	0	0	282,938
13	Fabricated Metals	45,258	52,953	0	0	600	0	98,811
14	Miscellaneous	8,733	84,861	0	0	1,000	0	94,594
15	Crude Petroleum	349,612	228,388	0	4,826	0	0	582,826
	TOTAL	4,859,543	6,046,257	40,029	2,977,087	79,656	1,301,774	15,304,346

1/Traffic between ports or landings wherein the entire movement takes place on inland waterways. (Also, movements involving carriage on both inland waterways and waters of the Great Lakes; inland movement that cross short stretches of open waters which link inland systems, marine products, sand and gravel taken directly from beds of the oceans, the Gulf of Mexico, and important arms thereof; and movements between offshore installations and inland waterways.)

2/Traffic moving into one waterway from another in the case of receiving waterway.

3/Traffic moving from one waterway into another, in the case of shipping waterway.

4/, 5/These terms are applied to movements within the confines of a river, intra-coastal waterway, canal, or a segment of one of these channels.

6/Traffic moving through a waterway to and from points on other waterways.

Because of the congestion problems expected to occur at Oliver Lock under without project conditions, the following nonstructural improvements were assumed to be in effect at the lock during the 50-year project life:

- -Mooring cells
- -Industry Self-Help
- -Ready-to-Serve
- -1 Up - 1 Down

These improvements were built into the estimated locking components times for modeling purposes rather than modeled, explicitly.

In addition, due to congestion problems at other key locks on the system under both with and without project conditions, various combinations of nonstructural improvements were tested and those which were found to have the greatest influence on increasing capacity were considered to be in place during the 50-year project life. These were:

Kentucky-Barkley
- -Ready-to-Serve
- -1 Up - 1 Down
- -3 tow bias wait for Kentucky before utilizing Barkley

Coffeeville and Demopolis
- -1 Up - 1 Down
- -Improved approach and locking times

Inner Harbor Navigation Canal
- -First In-First Out (found to be comparable to 1 Up - 1 Down)
- -Multitow Lockages

It should be noted that a ready-to-serve policy is only appropriate at those locks experiencing multicut lockages. Such is not the case at the IHNC--Demopolis or Coffeeville.

One structural change was introduced into the system for both with and without Oliver replacement modeling runs. Since an additional lock chamber is under construction at Pickwick Lock, the 1,000- by 110-foot lock chamber was considered to be in place for all future condition tests.

Electric Generating Facilities. Volume XVI of the National Hydroelectric Power Resources Study provides a regional assessment for the Southeast Electric Reliability Council and includes projections of power demands to the year 2000, as shown in Table 5. The resources in operation as of January 1979 and projected requirements through the year 2000 are shown in Table 6. Table 7 reflects expected additional resources needed to meet the projected demand and maintain reserve requirements. The tables do not consider the reduction in available resources resulting from retirement of older, less efficient plants. Examination of Table 7 shows that by the year 2000 an additional 118,000 MW of capacity is needed for the Southeastern Electric Reliability Council. The Southern Subregion alone will require 28,000 MW in additional capacity. These figures reflect an average annual increase of 4.7 percent.

Projected Economic Characteristics. Population and employment projections in Tuscaloosa County indicate a 43 percent growth during the 62 year period from 1978 to 2040. Per capita income, however, will increase 314 percent to $17,132 in 2040. In 1978, Government was the major income source, followed by manufacturing. This trend is projected to continue to the year 2040. Growth trends for Tuscaloosa County are shown in Table 8.

Recreation. The Alabama Statewide Comprehensive Outdoor Recreation Plan (SCORP) indicates the market area's 19 counties within the Black Warrior-Tombigbee region exhibit the following characteristics:

1. There is a large unmet need for fresh water fishing, picnicking tables, swimming pools, and big game hunting acres.

2. There is also a need for camping sites, pedestrian trails, bicycling trails, and waterfowl hunting acres.

3. There is not a need for waterskiing, power boating, sail boating, and small game hunting acres.

Table 5
DEMAND
BASE, INTERMEDIATE, PEAKING
(1000MW)

REGION	1978 B	1978 I	1978 P	1978 T 1/	1985 B	1985 I	1985 P	1985 T	1990 B	1990 I	1990 P	1990 T	1995 B	1995 I	1995 P	1995 T	2000 B	2000 I	2000 P	2000 T
VACAR	18.1	4.7	3.1	25.9	27.7	7.1	4.8	39.6	36.4	9.4	6.2	52.0	45.0	12.2	7.1	64.3	55.4	15.0	8.7	79.1
SOUTHERN	12.2	4.9	3.2	20.3	17.4	7.0	4.6	29.0	22.4	8.3	5.5	36.2	28.1	11.4	5.9	45.4	34.0	13.7	7.1	54.8
FLORIDA	10.1	3.6	3.2	16.9	15.8	5.5	5.0	26.3	20.0	7.0	6.4	33.4	24.5	8.6	7.8	40.9	28.5	11.5	10.0	50.0
TVA	14.4	4.3	2.8	21.5	21.8	6.5	4.3	32.6	26.9	7.9	4.7	39.5	31.3	9.7	5.0	46.0	36.1	11.0	5.2	52.3
SERC 2/	53.1	16.1	11.3	80.5	82.3	24.9	17.5	124.7	104.5	31.7	22.2	158.4	127.6	40.6	25.1	193.3	153.2	48.7	30.2	232.1

1/ Total demand is divided into percent base (B), intermediate (I), and peaking (P) based on the following projected generation mix (Harza, July 1980):

REGION	1978-85 B	1978-85 I	1978-85 P	1990 B	1990 I	1990 P	1995 B	1995 I	1995 P	2000 B	2000 I	2000 P
VACAR	70	18	12	70	18	12	70	19	11	70	19	11
SOUTHERN	60	24	16	62	23	15	62	25	13	62	25	13
FLORIDA	60	21	19	60	21	19	60	21	19	57	23	20
TVA	67	20	13	68	20	12	68	21	11	69	21	10
SERC	66	20	14	66	20	14	66	21	13	66	21	13

2/ The totals for SERC are less than the sum of the subregions since the peaks vary from summer to winter.

Table 6

RESOURCES
BASE, INTERMEDIATE, PEAKING
(1000 MW)

REGION	1978				1985				1990				1995				2000			
	B	I	P	T 1/	B	I	P	T 1/	B	I	P	T 2/	B	I	P	T 2/	B	I	P	T 2/
VACAR	26.8	6.4	4.2	35.4	35.9	9.2	6.2	51.3	43.3	11.2	7.4	61.9	53.1	14.4	8.4	75.9	64.8	17.6	10.2	92.6
SOUTHERN	14.9	6.0	3.9	24.8	21.7	8.7	5.7	36.1	27.9	10.3	6.7	44.9	32.9	13.3	6.9	53.1	39.8	16.0	8.3	64.1
FLORIDA	13.4	4.7	4.3	22.4	18.8	6.6	6.0	31.4	24.0	8.4	7.6	40.0	29.6	10.4	9.4	49.4	33.9	13.7	11.9	59.5
TVA	17.7	5.3	3.4	26.4	29.0	8.6	5.6	43.2	34.2	10.0	6.0	50.2	38.1	11.8	6.2	56.1	44.0	13.4	6.4	63.8
SERC	70.8	22.4	15.8	109.0	105.4	33.1	23.5	162.0	129.4	39.9	27.7	197.0	153.7	49.9	30.9	234.5	182.5	60.7	36.8	280.0

1/ Total resources existing in 1978 and projected for 1985 are from the 1979 NERC Report.

2/ Total resources for 1990, 1995 and 2000 are based on the projected demand shown in Table 4-12 plus the following expected percent reserve margins from DOE/RG-0036(Rev. 1), July 1980 and Harza, July 1980:

REGION	1990	1995	2000
VACAR	19	18	17
SOUTHERN	24	17	17
FLORIDA	20	21	19
TVA	27	22	22

3/ The base (B), intermediate (I), and peaking (P) resource amounts are derived using the generation mix given in Table 4-12.

Table 7

ADDITIONAL RESOURCES REQUIRED
BEYOND 1985
(1000 MW)

REGION	1990				1995				2000			
	B	I	P	T	B	I	P	T	B	I	P	T
VACAR	7.4	2.0	1.2	10.6	17.2	5.2	2.2	24.6	28.9	8.4	4.0	41.3
SOUTHERN	6.2	1.6	1.0	8.8	11.2	4.6	1.2	17.0	18.1	7.3	2.6	28.0
FLORIDA	5.2	1.8	1.6	8.6	10.8	3.8	3.4	18.0	15.1	7.1	5.9	28.1
TVA	5.2	1.4	0.4	7.0	9.1	3.2	0.6	12.9	15.0	4.8	0.8	20.6
SERC	24.0	6.8	4.2	35.0	48.3	16.8	7.4	72.5	77.1	27.6	13.3	118.0

Table 8

Projected Economic Characteristics
Black Warrior-Tombigbee Rivers Study Area

TUSCALOOSA COUNTY

	1978	1990	2000	2010	2020	2030	2040
Population	125,444	146,472	152,659	160,299	168,029	173,659	179,478
Income (per capita)	$ 4,142	$ 5,862	$ 7,589	$ 9,508	$ 11,493	$ 14,032	$ 17,132
Employment (Total)	53,253	64,470	69,364	73,141	74,003	75,065	76,152
Earnings by Industries (1972 - $1,000)							
Agriculture	$ 2,409	$ 2,274	$ 2,589	$ 3,004	$ 3,480	$ 4,046	$ 4,704
Mining	19,323	70,819	105,598	136,537	178,160	225,878	286,377
Contract Construction	27,239	40,265	53,046	68,959	85,138	106,093	132,206
Manufacturing	98,463	151,277	200,409	260,116	321,729	399,932	497,151
Trans.- Public Util.	22,477	38,713	54,095	72,616	91,459	115,297	145,348
Wholesale/Retail Trade	56,299	94,129	127,044	166,093	205,518	255,953	318,768
Finance, Insurance, Real Estate	15,837	27,210	38,044	51,232	64,651	81,879	103,698
Services	48,314	85,846	123,685	170,016	217,245	278,013	355,779
Government	124,490	173,971	224,715	287,031	350,671	432,652	533,847

SOURCE: OBERS, 1982 BEA.

Since the current Alabama SCORP projects into the year 2000, there seems to be a trend of the population's recreational demand exceeding the supply of recreation facilities into the future within the market area. Therefore, the future years will have an even greater demand for recreational activities within the Black Warrior-Tombigbee River region in Alabama. Table 9 displays the recreation needs in the vicinity of the city of Tuscaloosa.

Problems and Opportunities

Operators on the waterway have been concerned that a bottleneck is developing around the Oliver Lock. The dimensions of the lock (95 x 460) are not commensurate with other locks on the waterway which have chambers of 110 x 600. Delays as much as 10 hours have been experienced due to the increasing useage of 6-barge tows which must be broken apart and locked through in two sections. Estimates of future waterway commerce projections made during the mid-1970's indicated that the physical capacity of Oliver Lock would be reached during the decade of 2010 to 2020, if traffic was not constrained by delays at other locks in the system.

Based on the projected demands shown in Table 7, there will be a shortfall of 35,000 MW of electric generating capacity in 1990 with the shortfall increasing to 118,000 MW by the year 2000 for the Southern Electric Reliability Council. Additional generating capacity will be required and hydropower could be effectively utilized to reduce the shortfall

Finally, according to the 1981 Alabama SCORP, a need for additional fishing, camping, and picnicking facilities exists in the study area. Boat launching facilities serving the Oliver project are lacking, as well as access to bank fishing areas in the lake.

In summary, there exists a serious navigation problem due to the size of the Oliver Lock chamber and a potential deficit in electric power generating facilities. The opportunity to replace the small lock with a larger lock and add a small hydropower plant is evident. A boat ramp for

Table 9

Recreation Needs in Tuscaloosa, Bibb, Fayette, and Pickens Counties

		Net Needs (in facilities)			
Activity	Measurement	1980	1985	1990	2000
Camping-developed	sites	207	228	249	277
Pedestrian trails	miles	+34	+33	+32	+32
Fishing-freshwater	acres	24,236	26,729	29,339	32,555
Waterskiing	acres	+17,172	+16,936	+16,692	+16,383
Boating-power	acres	+14,888	+14,476	+14,052	+13,516
Boating-sail	acres	+22,221	+22,479	+22,478	+22,477
Picnicking	tables	318	376	439	518
Swimming					
a. pool	sq. ft.	110,906	119,525	128,439	139,446
b. river or lake	acres	+47	+46	+45	+44
Bicycling					
a. on trails	miles	1	1	1	1
b. not on trails	miles	276			
Sightseeing by vehicle	miles	+72	+70	+68	+65
Hunting					
a. Big game	acres	513,722	560,394	610,791	674,367
b. Small game	acres	+141,150	+128,239	+114,090	+96,447
c. Waterfowl	acres	6,482	6,678	6,876	8,777

+ Indicates a surplus or no need.

SOURCE: 1981 Alabama SCORP - Volume I.

project operations can be shared with public interests, thereby satisfying a very small part of the recreation needs.

Planning Constraints and Objectives

Planning constraints which were a concern during the study are summarized as follows:

- The waterway is primarily intended for navigation and other uses of the water resource should be compatible,
- Shippers using the waterway have requested that it remain open during construction of any new facility,
- The present lock chamber at Oliver Lock and Dam should not be replaced with a chamber of smaller size,
- The development of hydropower is limited by the amount of available water,
- Replacement alternatives must be consistent with local, regional, and state plans for land use,
- Any plan, as ultimately formulated, should provide the maximum net benefits possible,
- Annual benefits and costs should be based on a 50-year amortization period and the current discount rate,
- Annual charges should also include the cost of operation, maintenance, and major replacements, and
- Protection of cultural resources, wetlands and biological communities consistent with existing environmental legislation.

Objectives guiding the study are summarized below:

- Contribute to the economic efficiency of waterborne transportation on the BWT Waterway for the 1991 to 2040 period of analysis.

- Protect water quality and comply with State of Alabama water quality standards for health, aesthetics, and the sustenance of fish and other aquatic life for the 1991 to 2040 period of analysis.

- In conjunction with the project for navigation and hydropower, contribute to streambank wildlife habitat for the sustenance of wildlife species for the 1991 to 2040 period of analysis.

- In conjunction with the project for navigation and hydropower, contribute to outdoor recreation opportunities for the public for consistency with local and regional needs that would take advantage of project features for the 1991 to 2040 period of analysis.

- Contribute to the efforts being made to reduce dependency on non-renewable sources of energy by developing hydropower where ever sites are selected during the 1991 to 2040 period of analysis.

Management Measures

Management measures are possible solutions or parts of solutions which can be combined to develop the optimum plan. Description of such management measures for navigation and hydropower follows:

Navigation. Several alternatives for improvement of navigation at Oliver Lock were examined during the course of this study. Chief among these was the construction of a 110- x 600-foot lock. This would improve operating efficiency gained by providing a consistent size (110 x 600 feet) of lock to assure compatibility with existing locks on connecting waterways of the area. Alternatives are identified below and discussed in detail later in

this report. The Engineering, Cost, and Design Appendix contains drawings of the alternatives in Section III.

- Replacement lock using existing dam (Plans G and H in Table 10).

- Replacement lock using gated spillway at existing site (Alternatives #3 and #4 in Table 10).

- Replacement lock with new dam 2,700 feet downstream (Plans A thru F in Table 10).

- Replacement lock with new dam 8,000 feet downstream.

- Replacement lock with new dam 13,700 feet downstream.

- Use of nonstructural procedures.

Hydropower. A number of preliminary considerations for the addition of hydropower to Oliver Lock and Dam had failed to show economic justification. However, detailed studies found a change in economic conditions such as increasing fuel costs, scarcity of power generating facilities, and increased emphasis on developing small scale hydropower projects. These changed conditions makes the addition of hydropower to Oliver Lock and Dam more favorable and the following alternatives have been considered.

- Power plant located at existing lock and dam.

- Power plant located at downstream damsites.

- Plant sizes of 16.3, 13.2, and 10.1 MW.

Description Of Alternative Plans

Nonstructural Improvements

Nonstructural measures which were considered during the study include: (1) tow haulage unit; (2) extension of the guidewall; (3) extension of tow haulage unit beyond lock guidewall; and (4) demand management measures.

The advantage of the tow haulage unit is that the towboat would not be locked through with the first portion of its tow. After pushing part of its tow into the lock chamber, the towboat would be free to return to the remaining barges that await lockage. After the initial portion of the tow is hauled from the chamber, the lock is recycled and the towboat and remaining barges are locked through. Reconfiguration takes place along the lock wall. Time savings result when the towboat arranges a portion of its tow while the other portion is removed by the tow haulage unit from the lock and positioned along the guidewall. Extension of the tow haulage unit beyond the guidewall using piling was considered since it would allow a tow traveling in the opposite direction access to the lock chamber. While this would mean the lock would not be tied up by a single tow, the actual savings in time would not justify the expense. Extension of the guidewall would allow tows to remake on the guidewall while the lock is recycled to serve another tow traveling in the same direction as the first. The advantage of using the lock chamber while a tow remakes is expected to outweigh the disadvantage of recycling the lock with its attendant water loss and limitation to one way traffic.

Demand management measures such as application of a congestion fee have been proposed as a means of attaining the socially optimum traffic level on a congested waterway. The socially optimum level of traffic is that level where marginal shippers find their waterway rate savings equal their marginal towing costs for the waterway. When an additional cost is applied and the savings no longer justify the towing cost, the prudent marginal shipper will use another transportation mode. His decision to leave the waterway lessens congestion, hence the term congestion fee.

Structural Improvements

Restoration of Existing Lock (Plan I in Table 10). It is estimated that rehabilitation of Oliver Lock and Dam would prevent passage of river traffic for 10 months. Approximately 6,500 yards of concrete would be replaced; new miter gates and necessary equipment would be installed; tainter valves and related machinery would be replaced; and, hydraulic, electrical, and compressed air systems would be replaced. Other repairs would also be necessary for the lock. The existing Oliver Lock is a 95' x 460' lock with miter gates. Modification of the hydraulic characteristics of this lock would not be proposed if the lock were left in service. The spillway is a 700-foot long concrete ogee fixed crest at elevation 122.9. There is a right bank overflow dike at elevation 140.0 and water flows over the top of the lock wall on the left bank at elevation 140.0. This spillway would not be modified if the plan for upgrading the existing lock were selected.

Replacement Lock and Existing Dam (Alternative #1 in Table 10). A new larger size lock located on the landward side of the existing lock would require excavation of approximately 5,600,000 yards of material for the lock and approaches. The 110 x 600-foot chamber would be compatible with the remaining locks on the system. The Tuscaloosa County Club would be put out of business unless other lands for the golf course could be found. The Illinois Central Gulf Railroad bridge would be modified to permit access to the lock from upstream. A railroad spur would be relocated to the landward side of the new lock. Street realignments would be necessary if River Street gets joined with 32nd Avenue.

Replacement Lock and Spillway at Existing Site (Alternative #3 in Table 10). The existing lock and spillway could be replaced with a new 110- x 600-foot lock riverward of the existing lock with a gated spillway replacing the fixed crest spillway on the right descending bank of the river. This alternative has complex foundation engineering, but provides lock approaches that are excellent without railroad relocations. This plan

would provide the least disruption to adjoining topography and facilities. It would require removal of 3,100,000 cubic yards of material for the spillway approach and exit.

Replacement Lock and Dam Downstream (Alternative #2 in Table 10). Three downstream sites for a dam were investigated during the early 1970's. The sites located 13,700 and 8,000 feet downstream had the least favorable foundation conditions (see Geology Section of Engineering, Design, and Cost Appendix). Also, rock slopes downward from the Oliver Lock so that the sites further downstream would require greater excavation. Therefore, detailed examination was limited to the site located 2,700 feet downstream from Oliver. This was chosen mainly for foundation reasons but some consideration was given to navigation during construction. The three alternative spillways were considered at this site as follows: a fixed crest spillway, a gated spillway, and a combination gated and fixed crest spillway. All spillways were sized for a discharge capacity which would limit the swellhead of one foot on the left and right bank overflow dikes when they overtop and start passing flow. All designs considered the normal upper pool at elevation 123.0 with the spillway located between the new lock on the right descending bank and the power plant on the left descending bank. Slightly different amounts of excavation are required, depending on which spillway option is selected. A fixed crest spillway will require about 1,013,000 yards to be removed; the gated spillway requires only about 890,000 yards; and, the combination requires about 1,059,000 yards of excavation. The 110 x 600-foot lock would require 3,294,300 cubic yards of excavation regardless of the spillway option selected.

Hydropower Improvements Investigated. The Principles and Standards published by the Water Resources Council in 1979, permits small scale hydropower facilities (25 MW or less) to be examined without comparison to a nonstructural alternative. Therefore, nonstructural alternatives have not been developed for the small plants considered in this report. Concern was expressed over possible water quality problems associated with

operation of a hydroplant. Although the dissolved oxygen demand has been within acceptable standards in recent years, it was decided to include a turbine aeration system to maintain dissolved oxygen levels. Since no significant adverse environmental impacts would result from the size plants considered, an analysis of marketability may be used for the determination of need for future generation. The addition of hydropower is feasible for all navigation alternatives. Because of the differences in discharge characteristics of the spillway associated with the various alternatives, the quantity of average annual energy and installed plant capacity could vary slightly with each alternative. However, since these differences in average annual energy are slight, only two alternatives were investigated in detail for the three small hydropower plants considered. Replacement of the lock and spillway at the existing project was selected for hydropower capacity and energy evaluation because it is considered to be the most environmentally attractive plan. The fixed crest spillway alternative at the downstream site was selected because it is the most cost effective plan from a navigation standpoint. Slightly more average annual energy could be produced at the downstream site, because the spillway surcharge provides more head for discharges within the operating range of the hydroplant.

Screening of Alternative Measures

In order to concentrate on those measures or combination of measures which appear to offer the most complete solution to the problems and opportunities at Oliver Lock, it is necessary to withdraw from further consideration measures of lesser attributes. As an aid to this process Table 10 summarizes the costs of the navigation and hydropower. The nonstructural measures of a tow haulage unit, guidewall extension, and tow haulage extension were evaluated in a report titled "Report on Alternatives to Reduce Tow Delays, William B. Oliver Lock and Dam, Black Warrior-Tombigbee River System, Alabama," dated 30 October 1981. The evaluation indicated a time savings for two of these measures; however, net benefits accrued from only the tow haulage unit. The initial cost of the guidewall extensions precluded this measure from producing net benefits although there were time savings. An extension at a tow haulage unit beyond the present guidewall

was found infeasible and its delay reduction possibilities not computed. In addition, the report resulted in the recent construction of mooring cells at the existing lock which in effect denies any further time savings by the tow haulage unit or guidewall extension. Ultimately, to affect a solution to the navigational problems at Oliver Lock structural measures will be brought into play. Restoration of the existing lock to existing dimensions is not practical because of the severe economic impact on waterway users. A conveyor mechanism would be required to move commodities on the river during the rehabilitation and the resulting impacts, not only economically but socially and possibly environmentally could be expected to be significant. Similarly, construction of a new larger lock in the left bank is not as economical as other measures which provide the same product. Additionally, the social impacts of totally eliminating the Tuscaloosa Country Club are sizeable. Another nonstructural alternative to lock replacement is demand management through imposition of a congestion fee. The average annual benefits resulting from imposition of a congestion fee total $9,462,000, considerably less than the benefits realized from lock replacement.

The measure involving a larger replacement lock located about in the middle of the river at the existing damsite presents some engineering questions concerning foundation, hence a larger price tag than the downstream lock and dam location. However, there is less environmental impacts due to the smaller amount of disposal material and no need to enlarge the upper navigation pool. The downstream site does affect the Tuscaloosa Country Club as well as the half mile of riverbanks where the water elevation will be raised by 28 feet. The downstream measure using a fixed crest dam produces the same result in navigation terms as the gated or combination spillway measures at less cost. The fixed crest measure, however, does require the greatest area for disposal of excavated material of the three spillway measures. The fixed crest allows for navigation over the dam during high water; the gated spillway allows more flexibility in controlling pool elevation; and, the combination (fixed crest and gated) spillway does both to a limited degree. The disadvantages of gates are the initial cost and operation, maintenance and replacement costs.

The hydropower measures are in response to the opportunity to install a small plant to capture and translate the kinetic energy of the water flowing past the lock and dam. Energy independence has been a desirable social goal since the mid-70's. Since the measures proposed are all small, there is little environmental impact. As shown in the cost summary, the hydropower feature appears to be economically feasible.

Using this partially subjective and partially objective screening of the various measures, measures were combined into two alternatives for detailed investigation.

Final Array of Plans

The alternatives carried to further design and evaluation prior to plan selection were:

- o downstream lock of 110 x 600 feet and 16.3 MW powerplant (Alternative #2)
- o midstream lock of 110 x 600 feet and 16.3 MW powerplant (Alternatives # 3 and #4)

Alternative #4 resulted from a design change suggested late in the study which modified the spillway for Alternative #3 to fixed crest and 4 gates from the original 7-gate design. A significant cost savings was realized by this change as shown in Table 10.

The powerplant was combined with each of the three downstream spillway alternatives and the midstream alternative at the existing project. Adverse impacts on navigation by addition of hydropower to either the existing or proposed dam are not expected. The greater potential, however, would be concerned with releases from the powerplant installed at the existing project and the new lock in midstream.

Construction Schedule

A construction schedule has been developed with 1991 as the first year the replacement would be in operation. A schedule of events is provided in the section covering plan implementation.

Trade-Off Analysis

The largest trade-off that can be demonstrated is the difference between the development costs for the downstream alternative with fixed crest spillway and the midstream lock with gated and fixed crest spillways at the existing project site. Downstream the project cost is about 5 million dollars less than the midstream site. Geologic considerations increase the construction costs for the lock at midstream since it would be necessary to strengthen the existing lock due to excavation requirements. However, selection of the downstream site will require closure of the waterway for up to five weeks while the final stage cofferdam is being constructed. For purposes of determining the economic impact of the lock closure, the loss of income to tow operators on the BWT was utilized. While it is possible that these companies could move their equipment elsewhere on the inland waterway system, most of these companies are strictly local and in the past have ceased operations during closures of key locks on the waterway. It is difficult to assess what the economic loss to the shippers/receivers would be during this period due to the many different ways they react to scheduled shutdowns--some receivers stockpile in anticipation of the shutdown, some shippers stockpile during the shutdown, some shippers/receivers cease operations perhaps scheduling employee vacations (if possible), and some, if economically feasible, shift to another mode of transport for the duration.

The cost to the towing companies was computed using the January 1981 towboat and barge costs provided by OCE and updating them to October 1982 price levels. Based on this analysis, the lost income to the towing industry from the 5-week lock closure would be approximately $2,348,000. It should be noted, however, that it is likely that normal maintenance of

Table 10

Cost Summary for Alternative Measures ($1,000)[1]

	LOCK LOCATED ON RIGHT BANK 2700' DOWNSTREAM			LOCK LOCATED ON LEFT BANK		LOCK LOCATED MID STREAM	
	Fixed Crest & Gated Spillway	Gated Spillway	Fixed Crest Spillway	Fixed Crest Spillway	Rehabilitation on Existing Lock	Gated Spillway	4 Gate Spillway
Lock Size	110'x600'	110'x600'	110'x600'	110'x600'	95'x460'	110'x600'	110'x600'
Plan ID[2]	A	C	E	G	I	-	-
Alternative ID	-	-	ALT #2	ALT #1	-	ALT #3	ALT #4
Lands & Damages[3]	$2,100	$2,100	$2,100	$3,700	-	$1,500	$1,500
Structural							
Relocations				33,800			
Dam							
Spillway	23,500	27,000	16,100			35,000	16,200
Spillway Channel	4,500	3,000	4,600			4,300	11,600
Lock	56,600	56,600	56,600	58,200	15,700[4]	66,400	67,600
Access Roads	200	200	200	300		300	300
Channel							
Lock Approaches	13,000	13,000	13,000	18,200	2,400		
Spillway Removal	100	100	100				
Cultural Resources	100	100	100	100		100	100
Buildings, Grounds & Utilities	300	300	300	300		300	300
SUBTOTAL	100,400	102,400	93,100	114,600	18,100	118,700	97,600
E & D (7.0%)	7,000	7,200	6,500	8,000	1,300	8,300	6,800
S & A (5.5%)	5,500	5,600	5,100	6,300	1,000	6,500	5,400
STRUCTURAL TOTAL	117,900	115,200	104,700	128,900	20,400	133,500	109,800

Table 10 (cont)

Cost Summary for Alternative Measures ($1,000)1/

	LOCK LOCATED ON RIGHT BANK 2700' DOWNSTREAM			LOCK LOCATED ON LEFT BANK		LOCK LOCATED MID STREAM	
	Fixed Crest & Gated Spillway	Gated Spillway	Fixed Crest Spillway	Fixed Crest Spillway	Rehabilitation on Existing Lock	Gated Spillway	4 Gate Spillway
Hydropower5/							
Lands & Damage	600	600	600	600	600	600	600
Powerplant	15,200	15,200	15,200	15,200	15,200	15,200	15,200
Access Roads	100	100	100	100	100	100	100
E & D	1,800	1,800	1,800	1,800	1,800	1,800	1,800
S & A	1,200	1,200	1,200	1,200	1,200	1,200	1,200
Hydropower Total	18,900	18,900	18,900	18,900	18,900	18,900	18,900
GRAND TOTAL (Structural & Power)	131,800	134,100	123,600	147,800	39,300	152,400	128,700
Interest and Amortization (7-7/8% - 50 yr)	10,600	10,800	10,000	11,900	3,200	12,300	10,400
O, M & R	500	500	400	400	400	500	500
ANNUAL COST6/	11,100	11,300	10,400 7/	12,400	3,600	12,800	10,900

1/ October 1983 Price Levels.
2/ Plan identification initially used letters, however, after screening, the remaining plans were labeled alternatives.
3/ Lands and damages were specifically for alternatives 1, 2, and 3. Values were assigned to other plans based on similarities, land required for powerplant removed from estimate.
4/ Estimated time lock will be out of operation during rehabilitation of existing lock is approximately 10 months.
5/ Cost estimates from Feasibility Estimates for Small Scale Hydropower Additions.
6/ Does not include interest during construction.
7/ Annual cost including IDC is $12,642 as shown in Table A-V-7.

other locks on the BWT be scheduled to coincide with the lock closure, thus reducing the real time loss assigned to this alternative to 1 to 2 weeks. This would significantly reduce the income loss of this alternative to the towing industry.

The trade-off between spillway types amounted to analyzing their costs and the determination that an additional flexibility for controlling the pool level was not of value to either navigation or power.

Sensitivity Analysis, Risks, and Uncertainties

Sensitivity analyses have now been completed for both the navigation benefits and the cost of closing the river for up to five weeks during construction of a new dam. The cost to the waterway users for closing the river to traffic would have to exceed the annualized value of 5 million dollars to overcome the savings in construction gained at the downstream site. There is no doubt that sufficient coal resources can be found in the Black Warrior region to require adequate water transportation facilities well into the next century.

Facilities for meeting the study area's needs for power are being planned; however, several factors must be considered in the development and expansion of facilities. The record shows that timely installations have not taken place in recent years. The environmental costs for extraction of coal could slow down future development of coal-fired plants and the future of nuclear plants is unclear as is the import of foreign oil.

Several issues were examined during the course of this study. The possible shortage of lockage water at Holt Lock when traffic levels increased was examined in detail for the critical month of October. It was determined that upon completion of construction of Oliver Lock, traffic levels would increase to the point where regulatory measures would be necessary to allow uninterrupted service. However, it was concluded that such measures could be implemented without significant effects on traffic.

Because of the minor effect, measures such as water conservation and recirculation or pump back from the downstream pool were not considered advisable at this time.

Seventy-three bends and bridges on the lower BWT below Demopolis were identified as being potential congestion problems. These were modeled in the WAM and the congestion at each was monitored as traffic increased over the 50-year project life. It was found that none of the bends and bridges realized a significant delay which would warrant improvements. Additionally, it was found that the primary constraints on the waterway were the locks at Coffeeville and Demopolis rather than the bends or bridges. For example, in the year 2000, when the project is in place the average delay at the most congested bend was about 10 minutes. However, insignificant effects are accounted for in the assessment of project benefits.

Economic Analysis

System's Approach Economic Analysis

A major problem faced in the accurate benefit assessment of a lock and dam improvement project such as the replacement of Oliver Lock is the complex interdependence of traffic flows among the many different projects within the system. In a system as massive and diverse as the inland waterway system, a change in the performance capability of one project can conceivably affect the efficiencies of other projects in at least two ways --by increasing the aggregate service at other structures in the system (primarily locks), and by changing the economic and physical characteristics of the traffic at the other structures.

In the private sector, the economic influences exerted by one firm on another are "external" to the performance measures used by the first. The independent evaluation of a single component of the inland waterway system

has similar characteristics. Through the utilization of system analysis techniques, the external influences are internalized, and system performance becomes of primary importance. Therefore, the evaluation methodology and procedures used in this study have been developed in order to measure system performance. By evaluating the economic performance of the system, as defined by the proposed improvement at Oliver, the marginal system benefits attributable to that plan can be measured.

For purposes of this study, the "system" was defined based on determination of which segments of the inland waterway system could potentially be impacted to any significant degree by the project. Preliminary test runs of the overall system depicted in Figure 5 narrowed the system to the following waterways: BWT, TTW, Tennessee, Lower Ohio, Lower Mississippi, and GIWW East. All other segments of the inland waterway system were found to be extraneous to the purpose of this study, and therefore, were eliminated from detailed study. It was found through further analysis that the major impacts of the proposed improvement would be limited to the BWT Waterway, particularly Coffeeville and Demopolis Locks. However, as the Oliver Lock replacement was found to have some degree of impact on the marginal system benefits as defined above, these benefits are presented herein.

Marginal Economic Analysis

The theoretical applications of marginal economic analysis generally involve smooth, uniform, average and marginal costs and benefit curves. The real-world economic picture, however, is rarely that simplistic. Use of the ton-mile as the unit of measure for system output helps, to some extent, to standardize the view of production throughout the system. Yet, even with such standardization, some variability remains in the characteristics of output. As a result of this differentation in output, relationships between marginal costs and rate savings at alternative levels of output are somewhat erratic. In marginal analysis, incremental outputs

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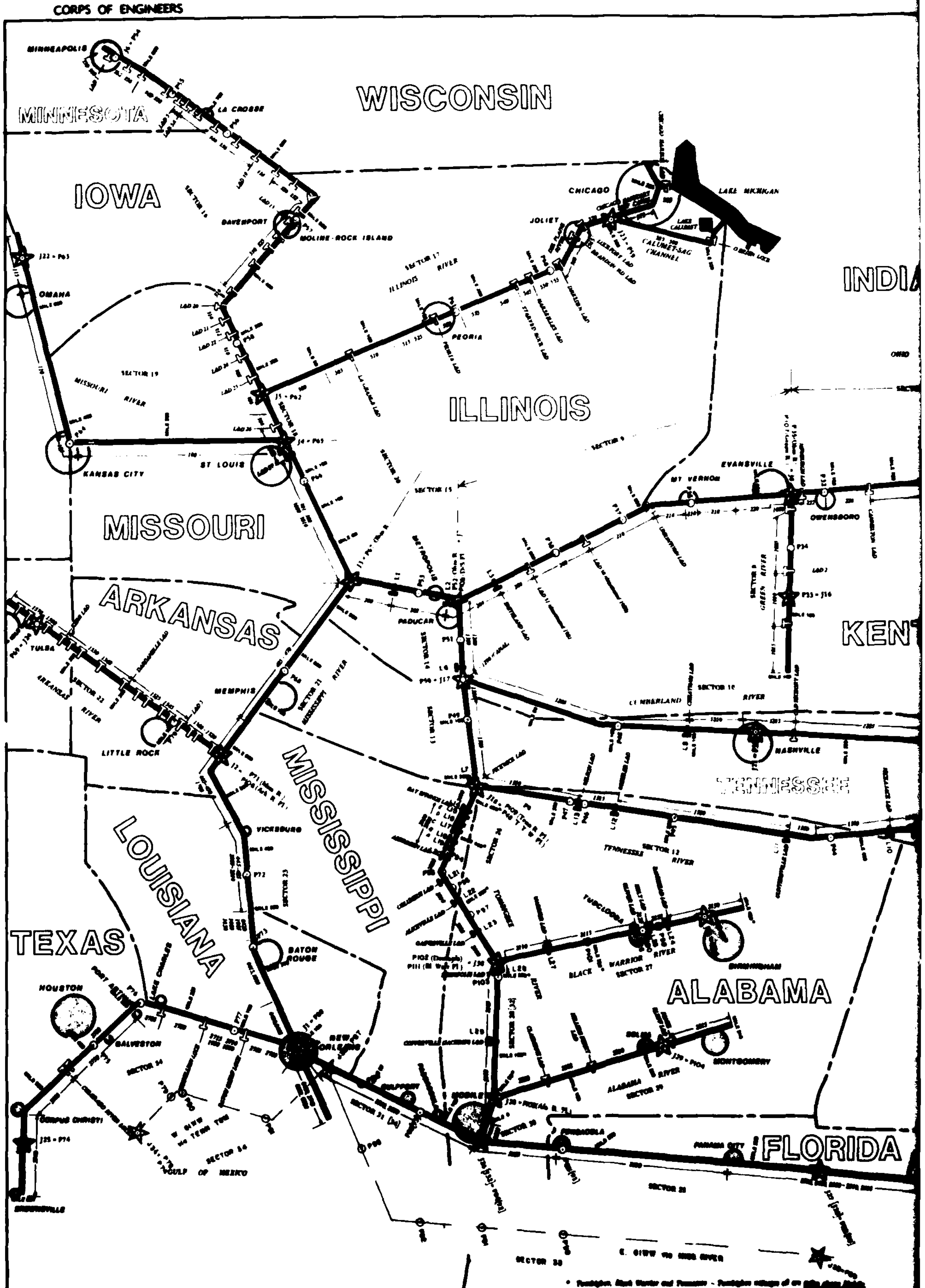

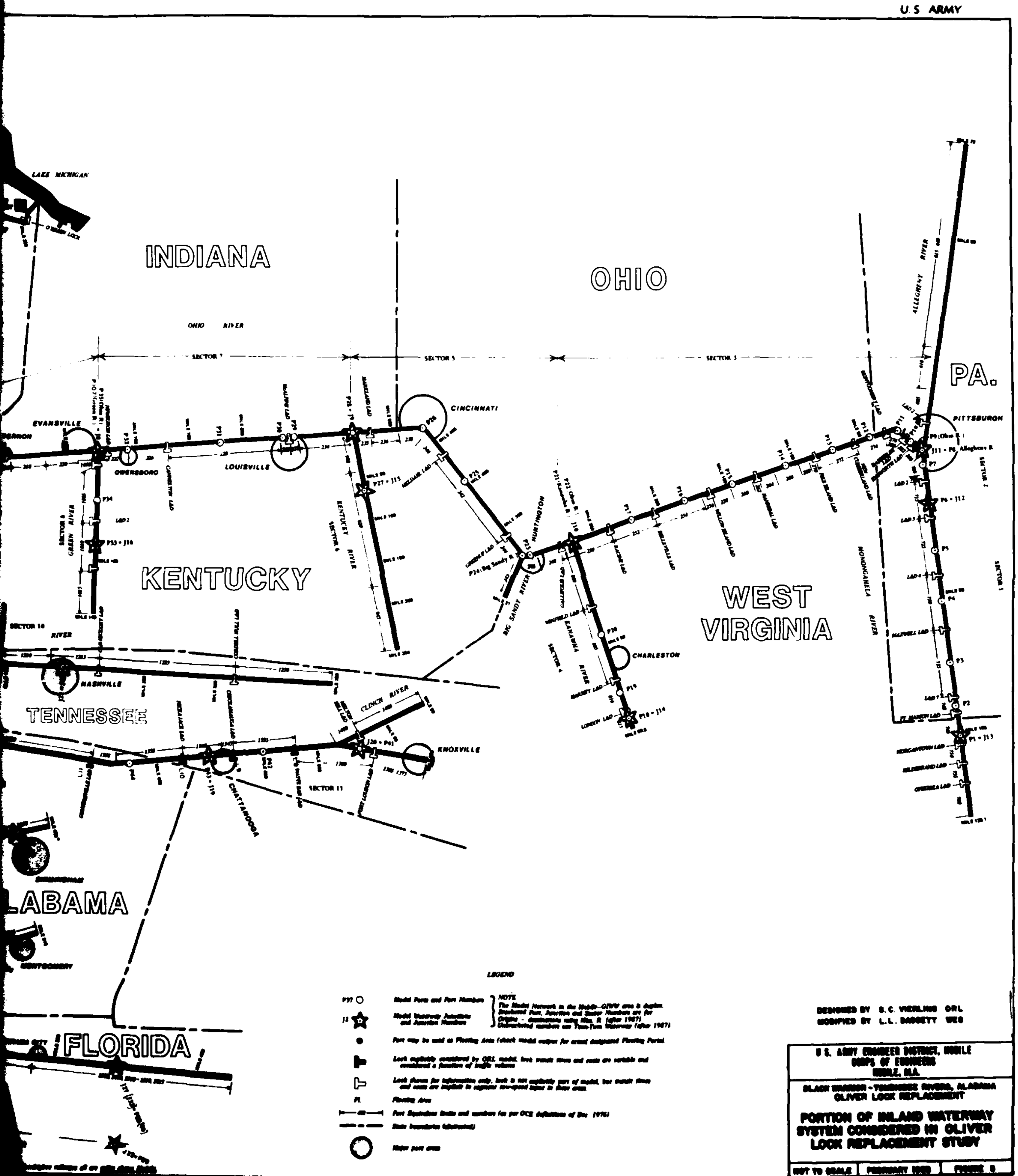
U.S. ARMY
LAKE MICHIGAN
INDIANA
OHIO
OHIO RIVER
SECTOR 7
SECTOR 5
SECTOR 3
ALLEGHENY RIVER
PA.
PITTSBURGH
CINCINNATI
EVANSVILLE
OWENSBORO
LOUISVILLE
P27 = J15
P53 = J16
KENTUCKY
KENTUCKY RIVER
GREEN RIVER
BIG SANDY RIVER
HUNTINGTON
WEST VIRGINIA
MONONGAHELA RIVER
KANAWHA RIVER
CHARLESTON
P18 = J14
P1 = J13
P6 = J12
SECTOR 10
NASHVILLE
TENNESSEE
CLINCH RIVER
KNOXVILLE
CHATTANOOGA
SECTOR 11
BIRMINGHAM
ALABAMA
MONTGOMERY
FLORIDA
LEGEND
Major port area
DESIGNED BY S. C. VIERLING ORL
MODIFIED BY L. L. DAGGETT WES
OLIVER LOCK REPLACEMENT
PORTION OF INLAND WATERWAY
SYSTEM CONSIDERED IN OLIVER
LOCK REPLACEMENT STUDY
NOT TO SCALE

(which occur in uneven quantities corresponding to movement size) are ranked in such a fashion so as to force a smooth benefit curve. Waterway line haul rates may tend towards a smooth curve, but marginal waterway routing costs (marginal costs) are less inclined to reflect a smooth curve. This phenomenon poses no real problem in this analysis since when the marginal costs begin to approach the rate savings the range of aggregate traffic levels around the social optimum is sufficiently narrow.

The marginal economic approach was used to determine the aggregate traffic levels that will move on the defined system and through Oliver under both with and without project conditions. The analysis determines the movements that would remain on the waterway and those which would divert to other modes and/or routes. This process was repeated for various years of traffic demand projections throughout the 50-year project life. Since the objective of this approach is to determine traffic and, ultimately, rate savings levels resulting under with and without project conditions, only those costs actually incurred by the waterway shippers are used in this process. Shippers use only those rates and charges which are internal to their production function to compute costs and to determine the extent of waterway usage. Therefore, only those portions of water facility costs which have been passed on to them by the towing industry are internalized.

Methodology and Procedures

Because the Black Warrior-Tombigbee Waterway is an integral part of a very complex national waterway system involving alternate routes and with locks that are potential bottlenecks, it was necessary to model a significant portion of that waterway to determine the system-wide impacts of replacing the Oliver Lock. The system was anticipated to involve not only locks as congestion points but also the lower Tombigbee River, a major segment that the Oliver traffic transits, which contains many tight bends that are constricted to one-way traffic and that cause the tows to slow. Due to the need to consider these bends as well as the locks, the modeling

methodology used in several recent studies by the Ohio River Division was modified to allow the modeling of congestion points in a waterway.

The basic modeling approach is founded on a model first developed under the inland Navigation Systems Analysis (INSA) Program and later modified by the Department of Transportation for the user fee study (Sec. 205) and the Huntington District for the Gallipolis Lock replacement study. The model is identified as the Tow Cost Model (TCM). It is an optimization model that sizes the tow traffic on the waterway based on the commodity movements, volume and pattern of movement, the equipment characteristics and costs, the restrictions on the tow sizes due to channel characteristics, the lock characteristics and delays, and potential for refleeting. The traffic is routed according to routing tables and the total traffic through the locks is determined. Based on this load, the locking characteristics are determined and the locking times and delay times computed. The delay times are determined based on a simple queuing model. Transit times through the reaches are then computed based on the tow sizes and channel characteristics. Using these factors and the cost of equipment and commodities, the optimum tow size for each movement (origin, destination, and transportation class) is determined.

Since this model uses a very simplified queuing model for the locking procedure delay and cannot determine realistically delays due to constrained channel points, a waterway simulation model was modified for this project. This model was also developed under the INSA Program; however, it was never successfully applied due to its complexity and large cost to operate. Also it did not have a readily available procedure to determine rate savings and project economics. The model is known as the Waterway Analysis Model (WAM) and is an event simulation model. The primary cost involved in using this model was the complete simulation of the fleeting, dispatching and port operations. However, since the TCM accomplishes an optimal sizing of the tows, considering backhaul potential and routes the traffic, these functions could be removed from the WAM and a trip generator could use the results from the resource requirements file to generate the traffic for the WAM.

In addition, the WAM was modified to allow the simulation of bends, because a mix of traffic could travel a given reach of the waterway and a particular bend could be transited as two-way or restricted to one-way traffic depending on the bend and tow characteristics. The model considers the size of the meeting tows in a bend and determines if the tows can both transit the bend or if one tow must wait. The rules of the Western Rivers are applied when a conflict occurs and queues are formed.

The complete locking procedure can be modeled in detail or as a simplified function. The lockage type is determined based on the size of the tow and the lock and lockage times are computed. If the lock is busy, the tow is forced to wait until its turn, based on the locking policy in effect. When two chambers are present, the most efficient chamber is chosen until the congestion is too great.

Statistics are kept on all events until the simulation period is ended. The lock's utilization and delays and bend delays are recorded. Each traffic movement also has records of the times for transit through the channel, through locks and through bends.

Based on the equipment and commodity costs, delay and transit times recorded for each movement, the cost of each shipment could be computed. As traffic increases and congestion occurs, costs will increase; thereby decreasing the waterway rate savings. A postprocessing program was used to determine these adjusted rates and to compute the resulting rate savings.

For each projected year the traffic was modeled in a network involving 29 locks and 34 waterway segments. The traffic was projected for each movement based on 1979 traffic reported in the Waterborne Commerce statistics according to OBERS projections. After the Tennessee-Tombigbee Waterway becomes operational, the Kearney projected movements were added. The characteristics of the locks were obtained from the performance monitoring system data collected at the locks during the 1979-1982 period. This data was used to calibrate the tow sizing. This traffic is then used in the TCM

and WAM for each year for the present system and with Oliver Lock replaced and operational improvements at Demopolis and Coffeeville Locks. The results of the queuing observed in the WAM and the capacity limitations would be used to adjust the TCM for each set of traffic conditions. As the traffic increased, the locks became congested and reached capacity. Traffic must then be diverted. The computed marginal rate savings usually has become negative for some of the traffic that is experiencing large delays. Those with negative marginal rate savings are diverted from the waterway and a new set of model runs made with the reduced traffic until the locks become uncongested. This interation is continued until the congestion is cleared and both the TCM and WAM can handle the traffic through all locks and the delays and lock processing times are similar for the TCM and WAM. Then the rate savings for the system and subsystem, with and without improvements can be compared to determine the benefits of the project.

Capacity of Oliver and Demopolis Locks

Capacity at Oliver, Coffeeville and Demopolis Locks were found to increase over the project life for two primary reasons. The first is because the average tow size is expected to increase as a result of the evidenced growth in economic costs associated with increased traffic at constraint points (primarily locks) along the waterway. In addition, the percent empty backhaul through BWT Locks decreased over the project life as a result of a more balanced composition of traffic. Oliver's capacity under without project conditions ranged from just over 19 million tons in 1991 to approximately 21 million tons in 2010. Demopolis and Coffeeville Locks ranged from just over 56 million tons in 1991 to over 60 million tons in 2010.

Project Costs

Table 10 lists both construction first cost and annual costs for the various measures examined during this study. Detailed cost estimates are contained in Appendix A, Section IV.

Project Benefits

Table 11 presents the navigation benefits that would accrue to the entire system over the 50-year project life. It can be observed that generally the overall benefits to the waterway begin at about $30.1 million and continue to grow to $42.0 million in the year 2010. It should be noted that for purposes of this analysis traffic projections were leveled off in 2010 and held constant for the remainder of project life. It is recognized that as a projection is extended further out in time, the credibility is increasingly weakened.

Table 11

Benefits to System, Oliver Lock Replacement
($1000)

Year	Benefits
1991	30,100
2000	34,800
2010	42,000
2020	42,000
2030	42,000
2040	42,000

Average Annual Equivalent Benefits: (000's $)

7-7/8% $35,700,000

Benefits from the production of hydropower were calculated using energy values provided by The Federal Energy Regulatory Commission. A credit for dependable capacity was used as well as a value for the average annual energy. The following table summarizes the benefits for the downstream plant sizes investigated.

Table 12

Hydropower Benefits

Oliver Lock Replacement

Installed Capacity	Dependable Capacity	Average Annual Energy	Annual Plant Factor	Power Values*	Benefits
(MW)	(MW)	(MWH)	(%)	(Capacity $/KW/yr) (Energy mills/KWH)	($1,000)
10.1	2.7	30,560	.35	130.05	351
				44.65	1,364
					1,715
13.2	3.4	39,400	.34	130.05	442
				44.65	1,759
					2,201
16.3	3.5	43,500	.30	130.05	455
				44.65	1,942
					2,397

*FERC Letter 9 May 1983. Coal-fired alternative power values were used for all plant factors.

Plan Selection

Both economic and environmental costs must be considered before the selected plan can be shown to maximize net benefits possible within the formulation framework. The economic costs for various measures have been considered and certain measures have been eliminated from further consideration. Environmental impacts have been considered and the statement following the main body of this report identifies these impacts.

Table 13 presents data for the comparison of costs benefits and net benefits for the downstream 110 x 600-foot lock, fixed crest spillway, and the 110 x 600-foot lock in midstream at the existing project. Power cost

Table 13

Summary of Data for Plan Formulation ($1,000)

		Annual Cost*	Benefits	Net Benefits	B/C
Navigation					
Alternative #2					
1st cost	104,700				
IDC	20,015				
Total	124,715				
I&A (7-7/8%)	10,048				
O, M & R[1/]	15				
Total	10,063	10,100	35,700	25,600	3.5
Alternative #4					
1st cost	109,800				
IDC	20,681				
Total	130,481				
I&A (7-7/8%)	10,512				
O, M & R[1/]	59				
Total	10,571	10,600	35,700	25,100	3.4
Power					
1st cost	18,900[2/]				
IDC	2,222				
Total	21,122				
I&A (7-7/8%)	1,701				
O, M & R	378				
Total	2,079	2,100	2,400	300	1.1

* Quantification of environmental costs in monetary terms has not been accomplished. The resulting impacts are essentially equal for both navigation measures with the exception that the midstream alternative requires less land for disposal. Environmental costs for power are minimal since generation by water displaces some power which would likely be generated by fossil fuel.

1/ The costs for O, M & R of the existing project have been deducted from the proposed project for this analysis.

2/ Assumes dam in place.

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and benefits are shown separate for ease of identification and can be added to either alternative to determine total project feasiblity. Based on these data, the downstream site with a fixed crest dam, a 110 x 600-foot lock, and a 16.3 MW powerplant produces the plan with maximum net benefits.

Selected Plan Description

Plan Components. Plate 1 depicts the tentatively selected plan which provides a 110 x 600-foot lock, fixed crest dam, and 16.3 MW power plant located about 2,700 feet downstream from the existing Oliver project. The depth of water over the upper and lower sills of the lock will be 13 feet. Access to the lock will be from the Northport, Alabama, side of the river. Approximately 140 acres of land in three parcels which belong to the city of Tuscaloosa, the Alabama State Docks and the Tuscaloosa Chamber of Commerce are planned for disposal area. Acquisition of 85 additional acres will be necessary for the lock site and another 37 acres are required for the powerplant and access thereto. Approximately 800 feet of Mill Creek will be removed during excavation of the lock approach.

The spillway will be 815 feet long with a crest elevation of 122.9 NGVD. A flip bucket will be provided to aid in aerating water flowing over the dam, but no stilling basin is planned due to rock foundation and tailwater depth. The 16.3 MW powerplant will be situated in the left descending bank of the river. It will contain a single unit. A switchyard will be provided and a proposed transmission right-of-way will be obtained for lines leaving the site in a southward direction. Power will be sold by the South Eastern Power Administration (SEPA).

Design and Construction Considerations. The construction of the proposed project will be accomplished in two stages. During the first stage, coffer cells would be temporarily erected in a portion of the river and the river bottom excavated within the area by mechanical means. The lock would then be constructed. Approximately 4 million cubic yards of material will be transferred to the disposal area which is about one-half

mile away. Navigation will be maintained during this stage of construction since only about one-half of the river will be blocked by the cofferdam.

Second stage construction will consist of damming the remaining portion of the river, constructing the remaining section of the spillway and dam, and installation of the powerplant. Material excavated from this construction stage will be transported to the disposal area located on the opposite side of the river. Bank areas left exposed due to excavation will be riprapped as needed to protect against sloughing and erosion due to prop wash and high water. Navigation will be stopped during the construction of the second stage cofferdam which will take about 5 weeks. When construction of the 2nd stage cofferdam is complete and the new navigation pool fills (about 2 days to fill) the new lock will be operational. As soon as possible after the new pool has filled, a 300-foot section of the old dam will be blown out to a depth of minus 20 feet. The debris will remain on the riverbed.

Coordination with the US Fish and Wildlife Service resulted in several recommendations which will be included in the construction specifications. In order to limit erosion, sedimentation, and turbidity from affecting fish spawning habits during construction, certain requirements will have to be carried out by the contractor. Prior to any construction, the contractor will be required to submit a plan showing his scheme for controlling erosion and disposing of waste. Surface drainage from cuts and fills within the construction limits, whether or not completed, and from borrow and waste disposal areas, shall, if turbidity producing materials are present, be held in suitable sedimentation ponds or shall be graded to control erosion within acceptable limits. Other requirements such as restoration of landscape damage and immediate grassing of disturbed areas will be enforced throughout construction.

Runoff protection within the disposal area will be provided by construction of a small dike around the disposal area to trap sediments. Drainage outlets will be provided as needed to control damage to adjacent properties. The dike will be grassed to control erosion. When the

disposal area is filled and the outside perimeter is protected with grasses, vines, and shrubs, the small dike will become part of the disposal area.

Flow in Mill Creek is not expected to be of sufficient volume or velocity to cause a problem with navigation past its mouth. The lock will discharge into the river and shoaling in the lock approach is not expected to be a problem.

Operation and Maintenance Considerations. The choice of a fixed crest spillway eliminates operation and maintenance costs for the spillway. The lock will be manned with at least five lock operators and a lock master which is no change from the requirements of the existing project. These personnel will handle small maintenance jobs while major repairs will be handled through the Area Engineer Office located in Tuscaloosa. The powerhouse will be operated by a crew of five people: two mechanics, one maintenance mechanic, and two electricians. Since the turbine and generator will be very small, certain powerplant equipment such as an overhead crane is not planned. Therefore, mobile cranes will be brought onto the site during major repairs of facilities located on either side of the river. Lock closures will be scheduled as needed for major repair work and advance notice to industry will be issued in the usual manner.

A boat launching ramp on Mill Creek will aid in maintenance operations necessary for the lock and powerplant as well as other inspection and maintenance work in the upper end of the Warrior pool. Minimum basic facilities consisting of a boat ramp, three spaces for vehicle parking, and the access road are proposed for more efficient accomplishment of snagging and dredging missions. Snagging is performed in the Warrior Pool by the Snagboat Ros and maintenance dredging is usually begun in the Warrior Pool on or about 1 April each year and is continued throughout the low water season. Both missions require trailered boat access for crew changes and inspection or supervision by Government personnel and survey parties. Condition surveys are also conducted year round. Maintenance dredging has increased, requiring addition of upland disposal sites at locations where disposal sites within the river have become filled to capacity. The

majority of dredging is performed in the upper portion of the Warrior Pool, between navigation miles 290 and 330. This part of Warrior Pool is presently served by one boat ramp, which is located at mile 304 and is owned and maintained by the Tuscaloosa County Recreation Authority. The Authority has reduced maintenance of their ramp due to lack of funds and they project no change in the future. A boat ramp at the proposed project, mile 337, could be located on Federal lands and would assure continued access for trailered boats to the Warrior Pool. Boating distance from the existing county ramp would be reduced considerably for much of the time, and overland distance to launch crew boats would also be reduced greatly because workers reside in the Tuscaloosa area. These savings are sufficient to justify minimum basic facilities.

Plan Accomplishments. The reduction of delays at Oliver Lock during the year is valued at $35,700,000. The production of 43,500 MWH annually means a boost of $2,400,000 to the economy. Additionally, the five jobs at the new plant will enhance the local economy. Navigation through the larger lock will be less difficult and more efficient. Small boating interests within the large population area will have improved access to the river. Land earmarked for future industrial development will initially be used for disposal of material excavated from the project area then returned for industrial uses. The potential for land enhancement was evaluated and it was found that incidental benefits of about $38,000 a year would accrue to owners. These benefits are small and no windfall would occur since they would be shared by three owners. The disposal lands cannot be used by the owners during the period of easement and they have no control over the material being placed on the land.

Summary of Economic, Environmental, and Other Social Effects. The development of a computer simulation model which mathematically predicts impacts of condition changes on the waterway system was used to analyze the impact of a new Oliver lock. A detailed description of the model and results can be found in the Economics Appendix. The summary of project economics shown below account only for benefits derived from transportation time savings and hydropower. Regional economic impacts from construction wages and sales associated with construction have not been computed.

Annual Costs	Annual Benfits	Net Benefits	B/C
$12,200,000	$38,100,000	$25,500,000	3.1

Although situated in an urban area, the existing Oliver Lock exudes a surprisingly quiet presence. Due, in most part, to limited access to the river, the land surrounding much of the lock site is undeveloped and grown up in trees. The country club is the nearest urban feature to the lock and presents more of a pastoral scene than urban. Construction of a new lock and dam will only slightly change these characteristics. The river will be wider and deeper between the existing lock and dam and the proposed lock and dam downstream. While trees will be felled for construction, the new riprapped banks will still be tree-lined. Access to the proposed lock will be improved and the availability of a boat ramp will also make the river more accessible.

A cultural resources study has been completed for all lands associated with the alternatives considered for replacement of Oliver Lock. The executive summary of the study is contained in the Environmental Appendix. The report identified 49 previously known and newly discovered prehistoric and historic cultural resources. Currently, ten of these resources are considered potentially eligible for the National Register of Historic Places and further investigations during preconstruction planning is appropriate.

The social impacts of the proposed lock are thought to be minor. There will be a loss of taxable land and the country club will have to alter its layout. However, offsetting these impacts are the beneficial impacts of increased employment, improved access to the river, and the reduction of delays experienced by shippers using the waterway.

A list of the effects of the selected plan on significant resources is given in Table 15 and the relationship of the plan to certain Federal policies and requirements is given in Table 16.

Table 14

Significant EQ Effects for the Tentatively Selected Plan (Alternative 2)

Significant Resources	EFFECTS ON EQ ATTRIBUTES			Other Social Effects	NOTES (see text of EIS for discussion of each significant Resource)
	Ecological	Cultural	Aestehtic		
Land-Use	No Significant Effect	No Effect	No Significant Effect	Adverse	Revegetation on disposal lands will occur after project completion. Disposal lands will continue to be suitable for development. Golf course lands will be permanently converted to project lands.
Community Cohesion	No Effect	No Effect	No Effect	No Effect	Temporary disturbance to nearby neighborhoods due to construction traffic and activities
Community Growth	No Effect	No Effect	No Effect	No Effect	
Housing	No Effect	No Effect	No Effect	No Effect	
Employment	No Effect	No Effect	No Effect	Beneficial	Additional jobs due to construction activities and powerplant operations.
Displacement of People	No Effect	No Effect	No Effect	No Effect	
Public Facilities and Services	No Effect	No Effect	No Effect	No Effect	
Transportation	No Effect	No Effect	No Effect	Beneficial	Reduced delays to river traffic.
Property Values	No Effect	No Effect	No Effect	No Effect	
Tax Values	No Effect	No Effect	No Effect	Adverse	Project lands would be Federal and therefore non-taxable.
Noise	No Significant Effect	No Effect	No Effect	No Effect	Noise disturbances as a result of construction activities would be short-term.

Table 14 (cont)

Significant EQ Effects for the Tentatively Selected Plan (Alternative 2)

Significant Resources	EFFECTS ON EQ ATTRIBUTES			Other Social Effects	NOTES (see text of EIS for discussion of each significant Resource)
	Ecological	Cultural	Aestehtic		
Leisure Activities	No Effect	No Effect	No Effect	Beneficial	Addition of a boat ramp will allow river access to small craft.
Aesthetics	No Significant Effect	No Effect	No Significant Effect	No Effect	Temporary adverse aesthetic impacts will be associated with construction activities and disposal sites
Riparian Environment	Adverse	No Effect	No Significant Effect	No Effect	Riparian lands of the Black Warrior Piver and Mill Creek will be inundated or permanently converted to project lands.
Threatened and Endangered Species	No Effect	No Effect	No Effect	No Effect	
Air Quality	No Effect	No Effect	No Effect	No Effect	
Water Quality	No Significant Effect	No Effect	No Effect	No Effect	Short-term negative impacts on water quality will be associated with construction activities.
Erosion	Beneficial	No Effect	Beneficial	No Effect	Existing eroding areas will be stabilized with riprap covering exposed, bare bluffs.
Benthos	Adverse	No Effect	No Effect	No Effect	Construction activities at the existing site and proposed site will disturb existing benthic communities.
Cultural Resources	No Effect	Adverse	No Effect	No Effect	Five cultural resource sites have been identified in the study area.

Table 15

Effects of the Recommended Plan (Alternative #2) on Resources of Principal National Recognition

Types of Resources	Principal Sources of National Recognition	Measurement of Effects
Air quality	Clean Air Act, as amended (42 USC 1857h-7, *et seq.*)	No effect.
Areas of particular concern within the coastal zone	Coastal Zone Management Act of 1972, as amended (16 USC 1451, *et seq.*)	Not present in the planning area.
Endangered and threatened species critical habitat	Endangered Species Act of 1973, as amended (16 USC 1531, *et seq.*)	Not present in the area.
Fish and Wildlife habitat	Fish and Wildlife Coordination Act (16 USC Sec 661 *et seq.*)	Aquatic habitat gained: 23 acres. Terrestrial habitat lost: 23 acres.
Flood plains	Executive Order 11988, Flood Plain Management	Does not encourage flood plain development.
Historical and cultural properties	National Historic Preservation Act of 1966 as amended (16 USC Sec 470 *et seq.*)	Adverse effect or 5 cultural resources.
Prime and unique farmland	CEQ Memorandum of August 1, 1980: Analysis of Impacts on Prime and Unique Agricultural Lands in Implementing the National Environmental Policy Act.	27 acres of prime and unique farmland are located in study area.
Water quality	Clean Water Act of 1977 (33 USC 1251, *et seq.*)	No effect.
Wetlands	Executive Order 11990, Protection of Wetlands Clean Water Act of 1977 (42 USC 1857h-7, *et seq.*)	Approximately 1-1/4 acres of sparsely vegetated, poor quality wetlands will be inundated.
Wild and scenic rivers	Wild and Scenic River Act, as amended (16 USC 1271, *et seq.*)	Not present in planning area.

Table 16

Relationship of Plans to Environmental Requirements, Protection Statutes, and Other Environmental Requirements

Federal Policies	Compliance
Federal Statutes	
Archaeological and Historic Preservation Act, as amended, 16 USC 469, _et seq_.	FC
Clean Air Act, as amended, 42 USC 1857h-7, _et seq_.	FC
Clean Water Act, as amended, (Federal Water Pollution Control Act) 33 USC 1251, _et seq_.	FC
Coastal Zone Management Act, as amended, 16 USC 1451, _et seq_.	NA
Endangered Species Act, as amended, 16 USC 1531, _et seq_.	FC
Estuary Protection Act, 16 USC 1221, _et seq_.	NA
Federal Water Project Recreation Act, as amended, 16 USC 460-1(12), _et seq_.	FC
Fish and Wildlife Coordination Act, as amended, 16 USC 661, _et seq_.	FC
Land and Water Conservation Fund Act, as amended, 16 USC 460l - 4601-11, _et seq_.	FC
Marine Protection, Research and Sanctuaries Act, 33 USC 1401, _et seq_.	NA
National Historic Preservation Act, as amended, 16 USC 470a, _et seq_.	FC
*National Environment Policy Act, as amended, 42 USC 4321, _et seq_.	PC
Rivers and Harbors Act, 33 USC 401, _et seq_.	FC
Watershed Protection and Flood Prevention Act, 16 USC 1001, _et seq_.	NA
Wild and Scenic Rivers Act, as amended, 16 USC 1271, _et seq_.	FC
Executive Orders, Memoranda, etc.	
Flood Plain Management (E.O. 11988)	FC
Protection of Wetlands (E.O. 11990)	FC
Environmental Effects Abroad of Major Federal Actions (E.O. 12114)	NA
Analysis of Impacts on Prime and Unique Farmlands (CEQ Memorandum 11 Aug 80)	FC

NOTES: The compliance categories used in this table were assigned based on the following definitions:

PC. Partial Compliance - Some requirements of the statutes, E.O., or other policy and related regulations remain to be met for this stage of planning.

FC. Full Compliance - All requirements of the statute, E.O., or other policy and related regulations have been met for this stage of planning.

NC. Noncompliance - None of the requirements of the statute, E.O., or other policy related regulations have been met for this stage of planning.

NA. Not Applicable - N/A statute, E.O., or other policy not applicable.

* Full compliance will be noted upon signing of the Record of Decision.

Plan Implementation

Institutional Requirements

Transportation savings gained by replacement of the Oliver Lock are specifically assigned to the inland navigation system. Historically, such benefits have been considered to be widespread since they are gained by multiple users and cost sharing has not been required. However, on 22 March 1982, the Department of the Army, on behalf of the Administration, transmitted proposed legislation to Congress which would provide for full recovery of costs for construction, rehabilitation, replacement, operation, and maintenance for most inland waterways with authorized depths of 14 feet or less. If this proposal is enacted by the Congress, the Secretary of the Army would also be authorized to employ a number of mechanisms to implement the laws, such as (1) license fees; (2) charges based on ton-miles over a given segment; (3) lockage fees; (4) tolls; and (5) charges based on capacity of cargo vessels over various segments of the inland waterway system. Additionally, the cost of hydropower has also been Federally financed with revenues from the sale of power used to repay the cost. However, any change in this method of financing which is acceptable to the President and Congress will be effected at the appropriate time.

Implementation Schedule

The steps necessary to implement the replacement of Oliver Lock are summarized as follows:

a. This report will be reviewed by the South Atlantic Division Engineer and forwarded to the Board of Engineers for Rivers and Harbors (BERH) upon approval. — August 1983

b. The report will be reviewed and approved by BERH. — December 1983

c.	The report will be forwarded, along with the BERH report, to the Chief of Engineers.	January 1984
d.	The report will be circulated to various agencies and the State of Alabama for comment.	March 1984
e.	Upon receipt of these comments, the Chief will prepare his report and submit the Oliver Report along with the BERH and Chief's report to the Assistant Secretary of the Army (ASA).	June 1984
f.	The Office, Chief of Engineers, will file the EIS with EPA.	June 1984
g.	The Assistant Secretary of Army (ASA) will review the reports and submit them for approval by the Office of Management and Budget (OMB).	September 1984
h.	The report will be forwarded to Congress by ASA.	October 1984
i.	Congress authorizes the project and appropriates funds before construction can begin.	FY 1984 and FY 1985
j.	Other activities leading to construction are:	
	1. Preparation of General and Feature Design Memorandums	FY 1986
	2. Real Estate acquisition	FY 1987
	3. Preparation of supply contracts	FY 1987
	4. Initiate construction of access roads, locks, and dams	FY 1987
k.	Open new lock to traffic.	April 1991

Local Cooperation

At this time, there are no financial requirements assigned to local interests, since lands for construction areas are generally acquired by the Federal Government. If Federal Law is modified prior to construction initiation, it would be appropriate to establish local cooperation at that time and complete the project under the then current laws.

Views of Other Agencies

The US Fish and Wildlife Service has participated in the development of this report and a draft of their Coordination Act report is provided in the Pertinent Correspondence Appendix. Other agencies have reviewed and commented on the draft. Their comments may also be found in Appendix D.

Summary Of Coordination

The study for replacement of Oliver Lock has been interrupted several times since it began in 1969. There have been two formal public meetings concerning the proposed replacement. The first was held on 19 May 1970, in Tuscaloosa, Alabama. It was the initial public meeting designed to expose the problems and opportunities for complete comprehension of the needs. Overall, the 37 statements received in response to the public notice were in favor of replacing the lock. The second was held on 28 March 1974, also in Tuscaloosa, Alabama. The basic options were presented for discussion at this public meeting. An environmental assessment was contained in the notice of the meeting. There were 13 presentations by attendees and 10 statements submitted for the record. The need for hydropower, another bridge across the Black Warrior, water quality, water quantity, and flood protection were discussed. The option of a replacement lock and dam located about 2,700 feet downstream of the existing project was supported by most of the waterway users during their presentations and prepared statements.

The Warrior-Tombigbee Development Association has been kept fully informed as the study progressed and their support in collection of traffic data and user-defined constraints has been very helpful. Several meetings with the membership have been held in the Mobile District Office and in the field to discuss user needs such as mooring facilities, quicker response to maintenance dredging, and other items. The District Engineer participates regularly as a speaker or panel member at the Association's annual meeting. Of special importance to this report was a meeting between the Alabama Congressional Delegation, members of the Association and members of the Corps which was held in Washington during the fall of 1980. It was decided at that time to prepare an interim report on the replacement of the Oliver Lock.

The US Fish and Wildlife Service (FWS) has been involved in the planning process throughout this study. A copy of the Fish and Wildlife Coordination Act report is provided in the Pertinent Correspondence Appendix. In this report, the FWS made a number of mitigation recommendations. Meetings were held between the Corps and the FWS to discuss their recommendations. The following responses were presented to the FWS.

FWS recommendation. Limit all construction activities and dredging to a time period other than the critical fish spawning season between March 15 and June 30.

Corps response. The construction of the proposed project would extend over three to four years. It would not be possible to avoid the spawning season because of the costs of demobilizing and mobilizing the construction activities several times during the course of the construction. The delays incurred would double the overall time necessary for project completion. However, construction would primarily be performed within coffercells which would minimize impacts and would not affect the up or downstream movement of fish although the small area within the coffercells would be unavailable for spawning beds.

FWS recommendation. Limit construction activities during high rainfall periods.

Corps response. This would be implemented (see page EIS-10).

FWS recommendation. Immediately revegetate all denuded areas.

Corps response. This would be implemented (see page 61).

FWS recommendation. Minimize vegetation disturbance associated with construction activities.

Corps response. This would be implemented (see page EIS-10).

FWS recommendation. Spoil disposal area lands should be managed for fish and wildlife production.

Corps response. The disposal area would not be purchased by the Corps. Only an easement would be obtained during construction. Therefore, no future management plans could be implemented on this land.

FWS recommendation. Use all lands remaining from the existing project for fish and wildlife production following the completion of the proposed project.

Corps response. The landscaping plan for project lands would consider measures which would benefit wildlife such as avoiding a total "lawn-like" setting by including some unmaintained thicket areas to provide small areas of cover for birds and small mammals.

FWS recommendation. Revegetate disposal area lands and other project lands with hardwood tree species in order to increase habitat value and productivity.

Corps response. The disposal area would not be purchased by the Corps. In addition, the present owners of the land intend to develop it for industrial use. Therefore, no planting scheme would be implemented. Natural revegetation would take place on the area until development occurs. See previous response concerning project lands.

FWS recommendation. A General Plan for management of all lands involved should be developed in cooperation with the Fish and Wildlife Service, State, and Corps.

Corps response. A General Plan would be developed for landscaping the project lands during future study stages and would include consideration of measures to benefit wildlife.

Appendix D contains pertinent correspondence related to study coordination efforts. One important effort which is continuing involves the Tuscaloosa Country Club Inc., whose lands will be impacted by any of the proposed plans. A consultant is developing a concept to allow relocation and continued operation of the Country Club during construction.

A final public meeting was held on 12 April 1983, with approximately 100 persons attending. Comments made at that meeting were very favorable towards replacement of Oliver Lock with a larger lock. The Tuscaloosa Country Club requested additional information relating to impacts on their operation resulting in the District obtaining the consultant mentioned above.

Conclusions

Based on the investigations made for this report, it is concluded that the traffic delay problem at Oliver Lock due to the use of 6-barge tows can best be solved by the construction of a new lock with dimensions of 110 x 600 feet. Additionally, the installation of a small hydropower plant in the dam on the opposite bank from the lock is feasible.

It is further concluded that Federal development of the replacement lock and dam including a powerplant would be in accordance with existing laws and policies and, that the small lake contained within steep riverbanks offers very limited potential for recreation development. A very small contribution toward meeting outdoor recreation needs will be provided by allowing public use of the basic facilities to be installed in Mill Creek near the lock.

After considering all technical information, public views, and in particular the economic, environmental and social well-being impacts, it is concluded that the selected plan herein warrants Federal participation. There does not appear to be a more appropriate alternative to construction and the proposed action includes all practical measures to minimize harm to endangered species, the surrounding wetlands and development in the flood plain. The proposed action has been evaluated in accordance with Section 404(b) guidelines of PL 92-500, as amended (Appendix C), and it has been determined that:

a. Feasible alternatives to the considered discharge have been considered and none that are practicable will have less adverse impact on the wetland ecosystem.

b. There are no unacceptable environmental impacts on the wetland ecosystem as a result of the dredge material discharge.

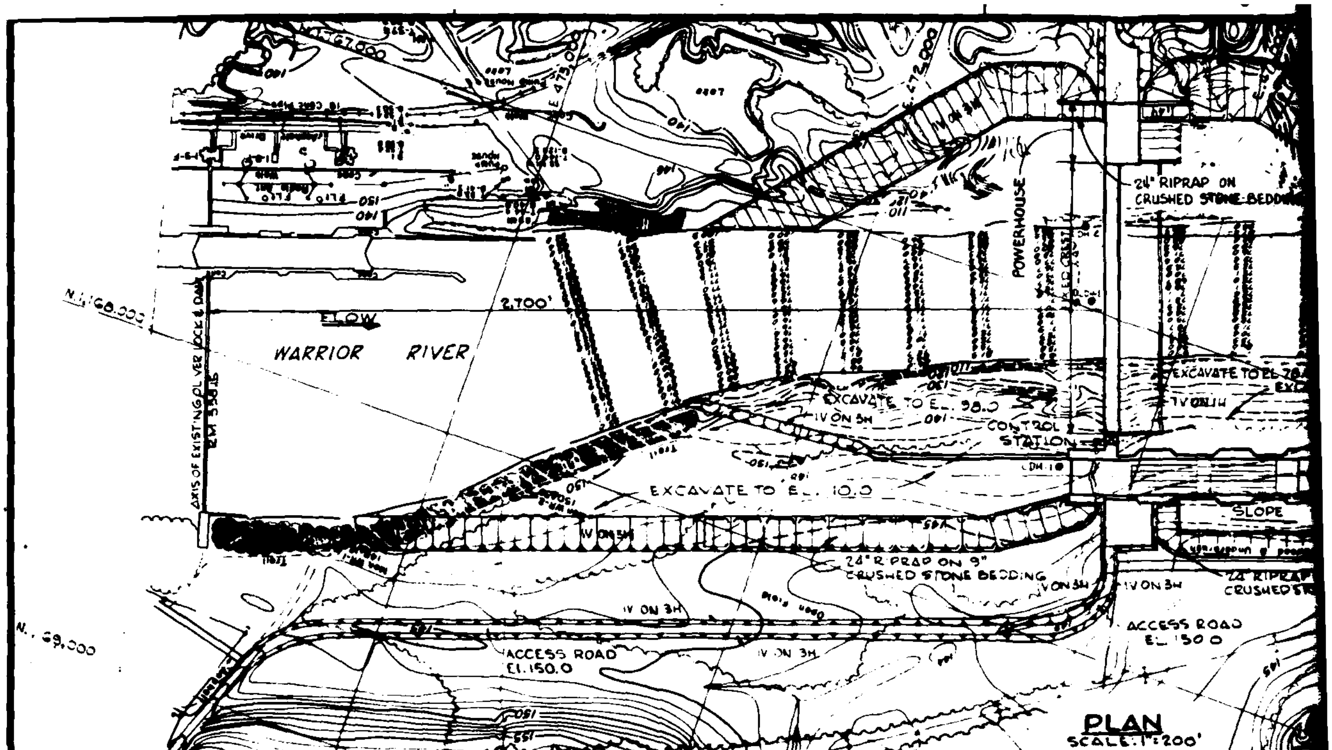
c. The discharge of the dredged or fill material will be accomplished under conditions which will minimize, to the extent practicable, adverse environmental effects on the aquatic and semiaquatic ecosystem.

Recommendation

I recommend that the plan to provide for the addition of hydropower and the improvement of navigation at William Bacon Oliver Lock in Tuscaloosa, Alabama, consisting of a lock with chamber dimensions of 110 x 600 feet, a powerplant and ancillary structures and facilities related thereto, be authorized for implementation as a Federal project, with such modifications as in the discretion of the Chief of Engineers may be advisable. This recommendation is made in recognition of current administrative initiatives before Congress on specific policies for Federal participation in water resources development. On 19 May 1983, the Department of the Army, on behalf of the Administration, transmitted proposed legislation to Congress which would provide for recovery of 70 percent of costs assigned to commercial waterway transportation for construction, rehabilitation, replacement, operation, and maintenance for most inland waterways with authorized depths 14 feet or less. If this proposal becomes law, Corps of Engineers expenditures for the Oliver Lock replacement project will be subject to recovery through user fees as set forth therein. The Secretary of the Army will be authorized to recover costs by imposition of ton-mile fees. Operation and maintenance costs will be recovered on a system-wide basis and future construction costs will be recovered on a segment-specific basis. Additionally, the Administration is considering a cost-sharing policy for development of hydropower. While some cost-sharing policies are still under consideration, it appears that non-Federal interests can expect a higher level of financial participation than in the past. Therefore, my recommendation for construction authorization of the Oliver Lock replacement project is made subject to cost-sharing policies satisfactory to the President and the Congress. The first cost of the Oliver Lock replacement project for the least costly alternative is currently estimated to be $123,600,000 with an additional operation, maintenance, and replacement cost of $393,000 annually.

Patrick J. Kelly

Patrick J. Kelly
Colonel, CE
District Engineer



PLAN
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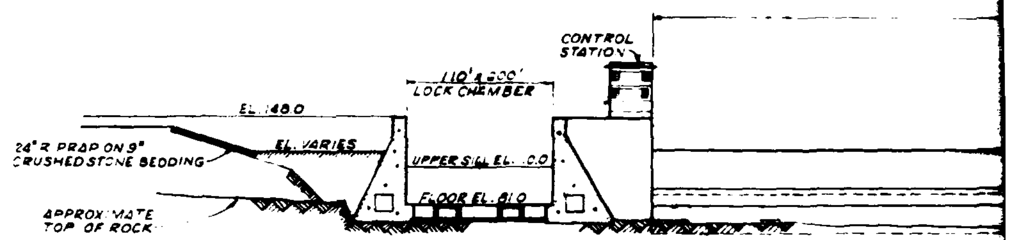

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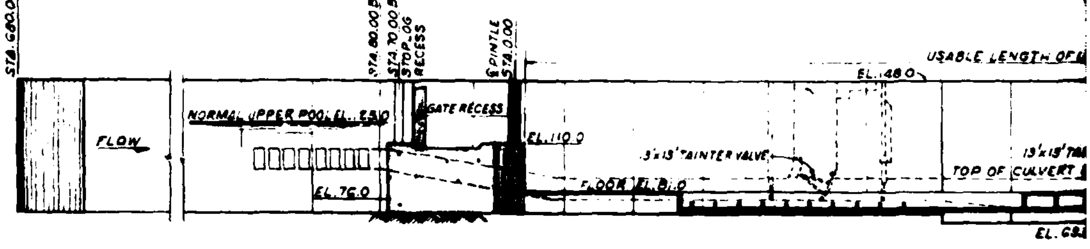

LONGITUDINAL SECTION THROUGH
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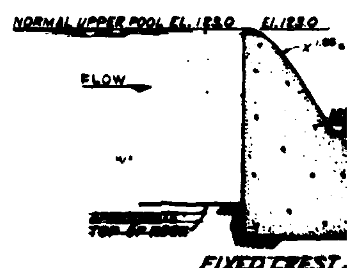
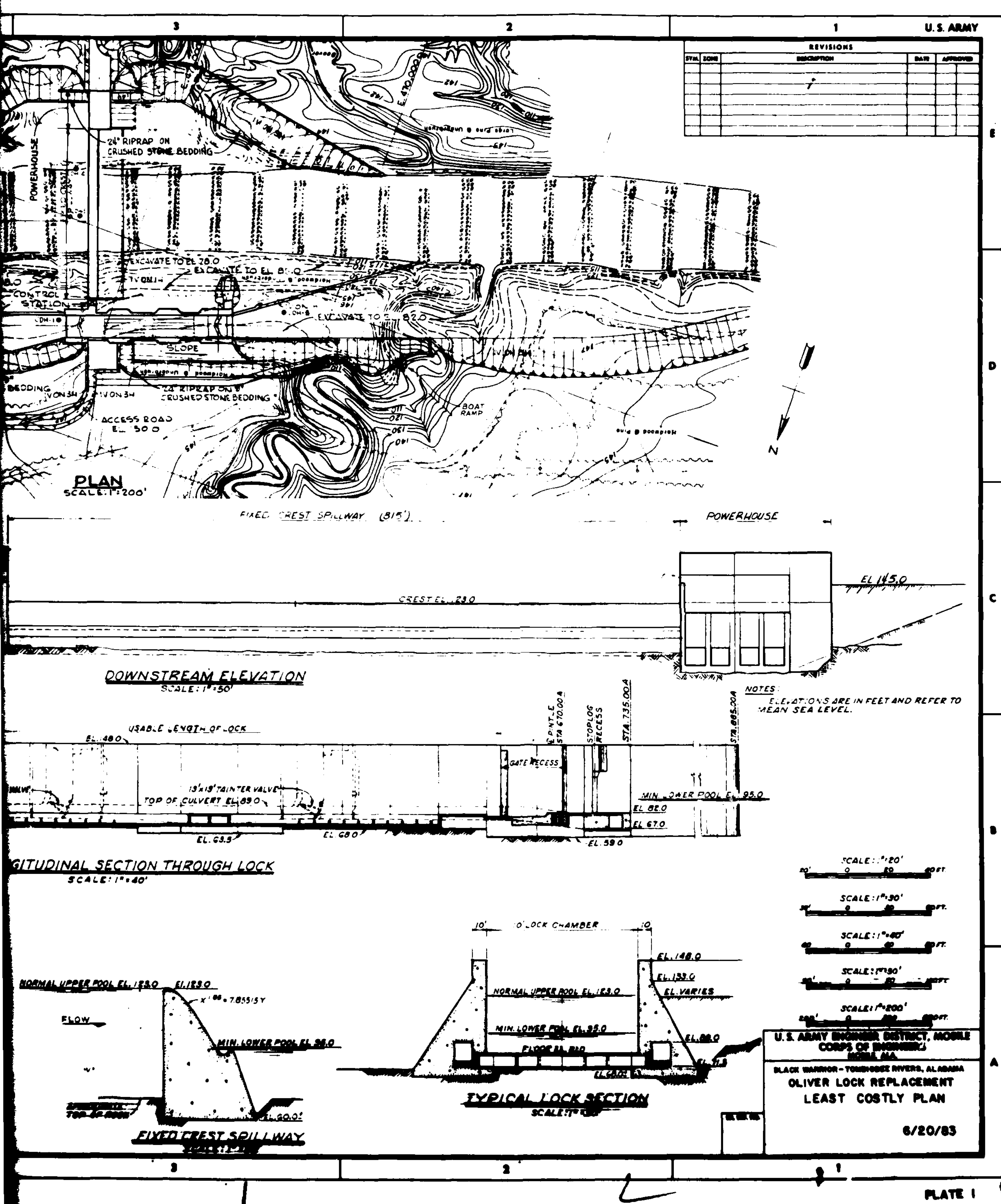


FIXED CREST



U.S. ARMY
REVISIONS
SYM. ZONE DESCRIPTION DATE APPROVED
24" RIPRAP ON CRUSHED STONE BEDDING
POWERHOUSE
EXCAVATE TO EL 20.0
EXCAVATE TO EL 80.0
CONTROL STATION
EXCAVATE TO EL 82.0
SLOPE
24" RIPRAP ON 9" CRUSHED STONE BEDDING
BEDDING
1V ON 3H
ACCESS ROAD EL 50.0
BOAT RAMP
N
PLAN
SCALE: 1"=200'
FIXED CREST SPILLWAY (815')
POWERHOUSE
EL 145.0
CREST EL 123.0
DOWNSTREAM ELEVATION
SCALE: 1"=50'
NOTES:
ELEVATIONS ARE IN FEET AND REFER TO MEAN SEA LEVEL.
USABLE LENGTH OF LOCK
EL 148.0
STA 670.00A
STOPLOG RECESS
STA 735.00A
STA 885.00A
GATE RECESS
13'x13' TAINTER VALVE
TOP OF CULVERT EL 83.0
MIN. LOWER POOL EL 95.0
EL 82.0
EL 67.0
EL 63.5
EL 68.0
EL 59.0
GITUDINAL SECTION THROUGH LOCK
SCALE: 1"=40'
SCALE: 1"=20'
SCALE: 1"=30'
SCALE: 1"=40'
SCALE: 1"=50'
SCALE: 1"=200'
NORMAL UPPER POOL EL 123.0
EL 123.0
FLOW
MIN. LOWER POOL EL 95.0
EL 60.0
FIXED CREST SPILLWAY
10'
LOCK CHAMBER
EL 148.0
EL 133.0
NORMAL UPPER POOL EL 123.0
EL VARIES
MIN. LOWER POOL EL 95.0
EL 88.0
TYPICAL LOCK SECTION
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.
BLACK WARRIOR - TOMBIGBEE RIVERS, ALABAMA
OLIVER LOCK REPLACEMENT
LEAST COSTLY PLAN
6/20/83
PLATE 1

FINAL

ENVIRONMENTAL IMPACT STATEMENT

FINAL
ENVIRONMENTAL IMPACT STATEMENT

Proposed Plan for Replacement of William Bacon
Oliver Lock and Dam, Tuscaloosa, Alabama

The responsible lead agency is the US Army Engineers District, Mobile

Abstract: The small size of William Bacon Oliver Lock and Dam in Tuscaloosa, Alabama, is not commensurant with the rest of the Black Warrior-Tombigbee River System. River traffic is being delayed due to a backup of tows at Oliver Lock and Dam. Plans which are being considered in response to this problem include the construction of a: (1) new larger lock on the left bank of the river using the existing dam with or without hydropower, (2) new fixed crest dam 2,700 feet downstream with a new larger lock on the Northport side of the river with or without hydropower, (3) the construction of a new larger lock near the middle of the existing dam with a gated spillway, (4) the construction of a new larger lock near the middle of the existing dam with a combination gated and fixed crest spillway with or without hydropower, and (5) no action. Alternative (2) with the addition of hydropower has been identified as the National Economic Development (NED) plan and the recommended plan because of economic considerations, and alternative (4) has been identified as the Least Environmentally Damaging (LED) plan because it affects the least amount of land. A boat ramp has been incorporated into the recommended plan primarily for maintenance although it will be available for public access. It will be located near the mouth of Mill Creek downstream of the proposed lock and dam.

SEND YOUR COMMENTS TO THE
DISTRICT ENGINEER BY

If you would like further information
on this statement, please contact:
Ms. Carol Gorbics or Tommy Lightcap
US Army Engineer District, Mobile
PO Box 2288
Mobile, AL 36628
Commercial Telephone: 205/690-2726
FTS Telephone: 537-2726

NOTE: Information, displays, maps, etc., discussed elsewhere in the Oliver Lock and Dam report are incorporated by reference in the EIS.

FINAL ENVIRONMENTAL IMPACT STATEMENT

Table of Contents

List of Tables

1.0 Summary

1.1 Major Conclusions and Findings. The recommended plan for replacement of Oliver Lock and Dam is the construction of a new lock and dam 2,700 feet downstream of the existing dam on the right bank of the Black Warrior River with a run-of-the-river hydropower plant on the left bank of the river (Appendix A, Chart III-2). This plan is recommended because it requires the least overall costs of the final array of alternatives (see Table 10 of the main report). Significant long-term environmental impacts of this plan are mainly associated with land use changes with 91 acres of land in the construction area and 139 acres of land in the disposal area being affected. The least environmentally damaging plan (LED) is the addition of a new lock in mid-river using the existing dam (Appendix A, Chart III-4). This alternative would impact 60 acres of land in the construction area and 80 acres of land in the disposal area.

1.2 Areas of Controversy. None have been identified at this time.

1.3 Relationship to Environmental Protection Statutes and Other Environmental Requirements. The specific areas of compliance are discussed for the recommended plan. Compliance is completed to the same degree for each alternative plan.

1.3.1 Cultural Resources. Under several historic preservation laws and one executive order, the Corps of Engineers has the responsibility to identify and preserve cultural resources or mitigate losses thereto, on lands under their jurisdiction. The pertinent authorities for this responsibility include the Antiquities Act of 1906, the Historic Sites Act of 1935, the National Historic Preservation Act of 1966 as amended including the National Historic Preservation Act Amendments of 1980, the Reservoir Salvage Act of 1960 as amended by the Archeological and Historic Preservation Act of 1974, Executive Order 11593 (Protection and Enhancement of Cultural Environment, 13 May 1981), the Archaeological Protection Act of 1979, and the National Environmental Policy Act. As part of the compliance procedure, a cultural resources reconnaissance survey has been completed of

the lands thus far identified for the Oliver Lock and Dam replacement study. A completed report has been received and filed with State Historic Preservation Officer for Alabama. This investigation resulted in the documentation of 49 previously known and newly discovered prehistoric and historic cultural resources. Currently, ten of the resources are considered potentially eligible for the National Register of Historic Places and are recommended for further investigations during the development of detailed plans and specifications. The proposed action is in full compliance with the above Executive Orders and Statute for the stage of planning.

1.3.2 Clean Air Act. In accordance with Sections 309 and 176(c) of the Clean Air Act, copies of the EIS were provided to the Environmental Protection Agency for review and comment. The proposed action is in full compliance with the stage of planning.

1.3.3 Section 404 of the Clean Water Act. In accordance with Section 404(r) of the Clean Water Act, the evaluation report was prepared under the provisions of Section 404(b)(1), included in the Environmental Appendix C, Section II and coordinated for review with this document. After considering all technical information, public views, and in particular the economic, environmental and social well-being impacts, it is concluded that the selected plan herein warrants Federal participation. There does not appear to be a more appropriate alternative to construction and the proposed action includes all practical measures to minimize harm to endangered species, the surrounding wetlands and development in the flood plain. The proposed action is in full compliance for this stage of planning.

1.3.4 Coastal Zone Management Act of 1972. No provisions of this act are applicable to this project.

1.3.5 Endangered Species Act of 1973. The FWS determined that the endangered American Alligator (*Alligator mississippiensis*) is the only endangered species which might be present in the vicinity of Tuscaloosa, Alabama. Since a survey by the US Fish and Wildlife Service (FWS) Endangered Species Office showed there to be no suitable habitat within the study area, it was concluded that the American alligator would not be significantly affected by the project. The proposed action is in full compliance with the provisions of the Endangered Species Act.

AD-A138 450 INTERIM FEASIBILITY REPORT AND ENVIRONMENTAL IMPACT STATEMENT FOR OLIVER..(U) CORPS OF ENGINEERS MOBILE AL MOBILE DISTRICT DEC 83 COESAM/PDW-83/001

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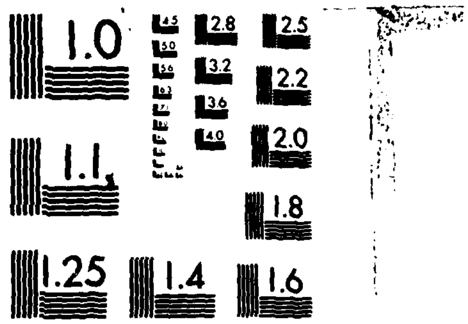
1.0
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1.3.6 Estuary Protection Act. No provisions of this act are applicable to this project.

1.3.7 Federal Water Project Recreation Act. The recommended plan includes provisions for a boat ramp downstream from the proposed lock and dam replacement. This ramp will be available for public use. Draft copies of this report were provided to the Department of Interior for conformance with the comprehensive outdoor recreation plan formulated by the Secretary of the Interior. The proposed project is in full compliance with the provisions of this act for this stage of planning.

1.3.8 Fish and Wildlife Coordination Act (FWCA). This project has been coordinated with the FWS pursuant to the provisions of this act. The FWS has provided a FWCA report which is included in the Pertinent Correspondence Appendix to this report. Fish and wildlife interests at the State level have reviewed the FWCA report and the draft feasibility report. The proposed project is in full compliance with the provisions of the act for this stage of planning.

1.3.9 Land and Water Conservation Fund Act. The requirements are the same as for the Federal Water Project Recreation Act.

1.3.10 Marine Protection Research and Sanctuaries Act of 1977. No provisions of this act are applicable to this study.

1.3.11 National Environmental Policy Act. Partial compliance of this act is made with the filing of the draft EIS. This study will be in full compliance when the Record of Decision is signed.

1.3.12 River and Harbor Act of 1899. No provisions of this act are applicable to this study.

1.3.13 Watershed Protection and Flood Preservation Act. No provisions of this act are applicable to this study.

1.3.14 Wild and Scenic Rivers Act. The Black Warrior River has not been designated as a wild or scenic river, nor is it under study for the

National Wild and Scenic River System. This study is in full compliance with the applicable provisions of this act.

1.3.15 Executive Order 11988, Flood Plain Management, 24 May 1977. The nature of this study dictates that it be located in the flood plain of the Black Warrior River. The proposed project does not directly or indirectly encourage future flood plain development in the study area. It also does not significantly adversely change the impact of floods on human safety, health, and welfare. This study is in full compliance with this order for this stage of planning.

1.3.16 Executive Order 11990, Protection of Wetlands, 24 May 1977. The wetlands impacted by the proposed project do not provide significant beneficial values to the surrounding environment. The nature of the proposed action provides that the dam extend through the wetland margin. There is no practicable alternative to the proposed construction and measures to minimize harm to wetlands have been included. The proposed action is in full compliance with this Executive Order for this stage of planning.

1.3.17 Executive Order 12114, Environmental Affects Abroad of Major Federal Actions, 4 January 1979. No provisions of ER-12114 are applicable to the proposed plan.

1.3.18 Council on Environmental Quality Memorandum, 11 August 1980, Analysis of Impacts on Prime or Unique Agricultural Lands. Approximately 27 acres of prime and unique farmland have been identified and will be affected in the proposed disposal area. This EIS was provided to the USDA for review and comment. The proposed action is in full compliance with the memorandum for this stage of planning.

1.3.19 Council on Environmental Quality Memorandum, 10 August 1980, Interagency Consultation to Avoid or Mitigate Adverse Effects on Rivers in the Nationwide Inventory. The Black Warrior River is not in the nationwide inventory.

2. NEED FOR AND OBJECTIVES OF ACTION

2.1 Study Authority: The authority for the replacement of Oliver Lock and Dam is contained in a resolution adopted on 21 April 1950 by the Committee

on Public Works of the House of Representatives, which requested the Corps to determine whether any modification of the existing navigation project on the Black Warrior and Tombigbee Rivers (BWT) between Mobile and Birmingham, Alabama, is advisable.

2.2 Public Concerns: Waterway users are concerned because the physical limitations of the existing Oliver Lock limits traffic on the BWT system. The dimensions of Oliver Lock (95 x 460 feet) are not commensurate with the remainder of the BWT Waterway System (110 x 600 feet). The larger locks on the BWT are capable of passing up to eight barge tows in a single lockage, while the existing Oliver Lock requires a double lockage of tows greater than four barges. Traffic on the BWT Waterway has developed faster than was projected by earlier Corps studies. Waterway commerce projections made during the mid-1970's indicated that the physical capacity of Oliver Lock would be reached during the decade of 2010 to 2020 if waterway traffic was not constrained by delays elsewhere in the BWT System. However, traffic on the waterway has developed faster than estimated and Oliver Lock is now expected to reach its practical capacity by 1987.

Concern has been expressed on a National scale for conservation of non-renewable resources. Hydropower development at small low head dams such as Oliver is being promoted by the Department of Energy and some environmentalists because this type of energy source could satisfy a portion of the regional energy demands at minimum cost to the environment. Use of a renewable resource such as hydropower could help to reduce dependence on fossil fuels.

2.3 Planning objectives: Planning constraints which were of concern during this study are summarized as follows:

- The waterway is primarily intended for navigation and other uses of the water resource should be compatible,

- Shippers using the waterway have requested that it remain open during construction of any new facility,

- The present lock chamber at Oliver Lock and Dam should not be replaced with a chamber of smaller size,
- The development of hydropower is limited by the amount of available water,
- Replacement alternatives must be consistent with local, regional, and state plans for land use,
- Any plan, as ultimately formulated, should provide the maximum net benefits possible,
- Annual benefits and costs should be based on a 50-year amortization period and the current discount rate of 7-7/8 percent,
- Annual charges should also include the cost of operation, maintenance, and major replacements, and
- Protection of cultural resources, wetlands and biological communities consistent with existing environmental legislation.

Objectives guiding the study are summarized below:

- Contribute to the economic efficiency of waterborne transportation on the BWT Waterway for the 1991 to 2040 period of analysis.
- Protect water quality and comply with State of Alabama water quality standards for health, aesthetics, and the sustenance of fish and other aquatic life for the 1991 to 2040 period of analysis.
- Contribute to streambank wildlife habitat for the sustenance of wildlife species for the 1991 to 2040 period of analysis.
- Contribute to outdoor recreation opportunities for the public for consistency with local and regional needs that would take advantage of project features for the 1991 to 2040 period of analysis.

- o Contribute to the efforts being made to reduce dependency on non-renewable sources of energy by developing hydropower wherever sites are selected during the 1991 to 2040 period of analysis.

3.0 ALTERNATIVES

3.1 Plans eliminated from further study. A summary of costs for various alternative measures is given in Table 10 of the main report. Detailed cost estimates are contained in the design and cost appendix. The amount of material necessary to be excavated and the loss of the country club are unaceptable for a lock alternative landward of Oliver; therefore, that alternative was screened out of further consideration. The rehabilitation of Oliver or construction of new locks with the same chamber size would continue congestion on the waterway and not meet the planning objective. Construction of a lock larger than others on the system would be impractical at this time. Nonstructural measures being considered would only provide temporary relief from navigational delays.

3.2 Without Conditions: The existing Federal project for the Black Warrior River provides for a 9- x 200-foot channel from Mobile Alabama, to the vicinity of Birmingham Alabama. The waterway presently includes six locks and dams, five of which have inside dimensions of 110 x 600 feet. Three of these, Coffeeville, Demopolis, and Warrior are located downstream from Oliver, while Holt and Bankhead are located upstream. Oliver Lock has dimensions of 95 x 460 feet.

Waterway commerce projections made during the mid-1970's indicated that the physical capacities of Oliver Lock would be reached during the decade of 2010 to 2020. However, traffic on the waterway has developed faster than estimated and Oliver Lock is now expected to reach its practical capacity by 1987.

Changes in overall environmental conditions for the Tuscaloosa area with the project are not likely to be significantly different from those changes

that would occur without the project. It is possible that traffic limitations on the waterway would place limitations on mineral extraction. Environmental damages associated with mineral extraction such as water quality degradation, habitat loss, and changes in soil structure and texture, would be lessened due to decreased activity. However, it is probable that other transportation routes such as railroads and trucks would supply the necessary transport mechanisms.

Recreational demands on the river system are expected to increase as population in the Tuscaloosa area increases. Recreational small boat access to the river in the vicinity of Tuscaloosa is limited to a boat ramp north of existing project site. Future additional access may not be developed.

The lands proposed to be used as a disposal area are included in a local development plan as being suitable for future industrial development. A portion of that area is considered prime development area. Therefore, It is unlikely then, that this area would remain a green area suitable for substantial wildlife use.

Future power demands show a need for the use of renewable resources such as hydropower. Lowhead dams like Oliver are considered to be suitable for hydropower developement.

3.3 Plans considered in detail. See the Engineering Design and Cost Appendix for detailed descriptions of each alternative plan. Table EIS 1 gives a summary of economic data, mitigation requirements and plan designations. The following plans are being considered in detail for this report:

(1) Existing dam and new larger lock landward on Tuscaloosa side of river (left bank), with or without hydropower (Appendix A, Chart III-1).

(2) New fixed crest dam 2,700 feet downstream and a new lock on the Northport side of the river with or without hydropower (Appendix A, Chart III-2) (recommended alternative with hydropower and NED plan).

Table EIS 1. Summary of Selected Features of Alternatives Considered in Detail.

Alternative	Economic Data ($1,000) Costs[1/]	Benefits	B/C Ratio	Implementation Responsibility Federal	Non-Federal	Mitigation[2/] Requirements	Plan Designations
1	11,900	38,100	3.2	100%	-	None	-
2	10,000	38,100	3.8	100%	-	None	NED, Selected Plan
3	12,300	38,100	3.1	100%	-	None	-
4	10,400	38,100	3.7	100%	-	None	LED

1/ Annualized FIRST COST at 7-7/8% for 50 years.

2/ Coordination with US Fish and Wildlife Service resulted in several suggested mitigative efforts. However, as addressed in the coordination section of the main text, there will be no mitigation for any of the alternatives other than the provision of the launching ramp chiefly for operations and maintenance of the lock but available for public use.

(3) Existing dam and new larger lock near the middle of the dam, riverward of the existing lock with a gated spillway, with or without hydropower (Appendix A, Chart III-3).

(4) Existing dam and new larger lock near the middle of the dam riverward of the existing lock with a combination fixed crest and gated spillway, with or without hydropower (Appendix A, Chart III-4).

(5) No action. The existing lock and dam will continue operating as it has in the past.

In addition, a boat ramp has been developed for incorporation into the recommended alternative (alternative 2) (Appendix A, Chart III-2). It would be located near the mouth of Mill Creek downstream of the proposed lock and dam. The specifications for the boat ramp are given in the Engineering Design and Cost Appendix.

Because the following measures have already been incorporated into the proposed alternatives and serve to avoid any major impacts, no specific mitigation plan was deemed necessary: natural revegetation of the disposal areas, minimization of vegetative disturbance to the extent practical, allowing additional public access to the river via the maintenance boat ramp and limiting construction activities during high rainfall.

Due to recent proposals concerning cost-sharing for Federal water resources development, cost-sharing plans have not yet been finalized. On 19 May 1983, the Department of the Army, on behalf of the Administration, transmitted proposed legislation to Congress which would provide for recovery of 70 percent of costs assigned to commercial waterway transportation for construction, rehabilitation, replacement, operation, and maintenance for most inland waterways with authorized depths 14 feet or less. If this proposal becomes law, Corps of Engineers expenditures for the Oliver Lock replacement project will be subject to recovery through user fees as set forth herein. The Secretary of the Army will be authorized to recover costs by imposition of ton-mile fees. Operation and maintenance costs will

be recovered on a system-wide basis and future construction costs will be recovered on a segment-specific basis. Additionally, the Administration is considering a cost-sharing policy for development of hydropower. While some cost-sharing policies are still under consideration, it appears that non-Federal interests can expect a higher level of financial participation than in the past.

4.0 AFFECTED ENVIRONMENT

4.1 General Environmental Conditions: Oliver Lock and Dam is located on the Black Warrior River at river mile 346.27 (Figure 1 of the main report). It is located in Tuscaloosa County, within the corporate limits of the city of Tuscaloosa, Alabama which is on the left bank of the Black Warrior River. The city of Northport is on the right bank.

The Black Warrior River is formed by the junction of the Locust and Mulberry Forks approximately 20 miles west of Birmingham and flows southwestward 45 river miles to Tuscaloosa, and then southward 120 miles to its confluence with the Tombigbee River at Demopolis, Alabama.

Oliver Dam forms Oliver Pool which is a run-of-the-river impoundment having a surface area of 790 acres. The pool is 8.8 miles long and has a storage volume of 12,340 acre-feet at the normal pool elevation of 122.9 NGVD and a tailrace elevation of 95.0 NGVD. Holt Lock and Dam is located 8.8 river miles upstream of Oliver Lock and Dam and Warrior Lock and Dam is located 76.7 river miles south of Oliver Lock and Dam.

Tuscaloosa County has a total area of approximately 857,600 acres. The land-use breakdown is shown in Table 2 of the main report. The estimated 1980 population of Tuscaloosa County was 137,541. Manufacturing and retail trade establishments are the dominant sources of employment in the county (County Business Patterns, Alabama, 1979 and US Department of Commerce, Bureau of the Census).

The study area has a temperate, subtropical climate characterized by moderate temperature variations and a high humidity. The average annual temperature is about 65 degrees Fahrenheit, ranging from an average winter temperature of about 49 degrees to an average summer temperature of about 81 degrees. The average annual rainfall of 53 inches is distributed relatively evenly throughout the year.

The elevation of the study area is generally below 150 feet NGVD and subject to occasional flooding. Topography in the study area is dominated by low gently rolling formations of the coastal plain. Soils along the Black Warrior River and its tributaries are generally flood prone soils of medium and fine texture. The banks of the Black Warrior River are generally characterized by a southern flood plain forest type. Significant stands of marketable timber are absent. High quality wildlife habitat in the study area is limited due to the proximity of human activities (the city of Tuscaloosa on the left bank of the river and the city of Northport and the Tuscaloosa Airport on the right bank of the river).

4.3 Significant Resources:

4.3.1 Land Use: Land use data for Tuscaloosa County are given in Table 2 in the main report. Land use on the left bank of the river in the vicinity of the study area consists of the existing lock and damsite, the Tuscaloosa Country Club Golf Course, the Gulf, Mobile and Ohio (GM&O) railroad track and forested areas. The existing project site is used primarily by lock and dam personnel, tourists and fishermen who use the river banks around the dam for bank fishing. A railroad runs between the golf course and the existing project lands. It is a spur of the GM&O railroad serving as an access line to the lands of the Hunt Oil Company and B. F. Goodrich Company terminates downstream of the existing Oliver Lock and Dam. The remainder of the area is forested lands with open areas interspersed.

The right bank of the river in the vicinity of the study area consists primarily of undeveloped lands. A power line right-of-way traverses the proposed disposal area (Appendix A, Charts III-2 and III-5). Mixed pine and hardwoods interspersed with old fields cover the area. Mill Creek runs

along the western boundary of the area emptying into the Black Warrior River approximately 4,500 feet downstream of the existing dam. Twenty-seven acres of land with soil types which are classified as prime and unique farmland are located in the proposed disposal area. However, these lands are not farmed and have been designated as future industrial development areas by local development plans.

4.3.2 Community Cohesion: A residential area predominated by single family housing backs the Tuscaloosa Country Club on the left bank of the river. The nearest access to the left bank of the river below the present lock and dam would be either through this residential area or via Old Sanders Ferry Road which would avoid residential streets.

4.3.3 Community Growth: Not significantly affected in the study area.

4.3.4 Housing: Not significantly affected in the study area.

4.3.5 Employment: Manufacturing, wholesale and retail, and government make up approximately 70 percent of the Tuscaloosa County area employment. Due to the urban nature of the study area very little agricultural activity occurs except on the outskirts of Northport and Tuscaloosa. The 1979 per capita income for persons 15 years and older in Tuscaloosa County was $5,684. This compares with a 1979 per capita income for persons 15 years and older of $5,894 for the State of Alabama.

4.3.6 Displacement of people: Not significantly affected in the study area.

4.3.7 Public Facilities: Not significantly affected in the study area.

4.3.8 Public Services: Not significantly affected in the study area.

4.3.9 Transportation: There are no heavily used thoroughfares running through the study area. The approach to the locksite on the left bank of

the river is a small sparsely traveled road used almost entirely by lock personnel and visitors to the site. The forested area on the right bank is traversed by a series of dirt roads. It appears there is little public use of this area because roads are poor and rutted in places.

4.3.10 Property Values: Not significantly affected in study area.

4.3.11 Tax Values: The lands which are being considered for future project lands are presently providing taxes to the city of Tuscaloosa. The Federal project lands at the existing project are non-taxable.

4.3.12 Noise: Present sources of noise in the vicinity of Oliver Lock and Dam are the railroad adjacent to the project area, the airport across the river from the present lock, operation of the lock, and the highway bridge traffic located upstream from the lock and damsite. The disturbance in the study area created by these sources of noise primarily affects the lock personnel and the golf course users adjacent to the locksite. Noise is not considered a major problem in the vicinity of the lock and dam.

4.3.13 Leisure Opportunities: Recreational and leisure activities associated with Oliver Lock and Dam are limited due to the lack of facilities. The only public owned areas are the east and west banks of the river at Oliver Lock and Dam, which are used for bank fishing. The remaining areas are privately owned. Table 3 of the main report shows recreational man-day use for Oliver, Holt and Warrior pools for 1980. Fishing and sightseeing comprise the majority of use. Bank fishing on both the left and right banks of the Black Warrior River at Oliver Lock and Dam is commonplace. Greater use at Holt and Warrior pools is due to the greater number of public areas.

4.3.14 Aesthetics: A portion of the study area on the left bank of the river includes part of a golf course which is maintained by the Tuscaloosa Country Club. The remaining areas (other than the existing project lands) are undeveloped lands of forested and vacant areas providing a green belt

along the bank of the Black Warrior River. Portions of the land on the right bank have been used for dumping of refuse which creates a visual blight. However, the area appears sparsely used so the aesthetic impacts of the dumping areas are probably slight.

4.3.15 Riparian Environment: The distribution of plants and animals in the Black Warrior River basin is affected by the natural geological phenomenon designated as the Fall Line where the river transitions from a narrow, rock valley to a broad valley with many stream meanders. Vegetatively, the project area is located within the general intergradation of the northernmost limit of the southern flood plain forest and the southern limit of the oak-hickory-pine forest. The forest types typical of the oak-hickory-pine complex occur on the higher, drier slopes with representative plants of the southern flood plain forest along the Black Warrior River.

Water oak, willow oak, sycamore, river birch, eastern cottonwood, black willow, red mulberry, planer tree, ironwood, American elm, and hackberry are common trees along the river bank in the immediate study area, including the downstream areas and disposal areas. Loblolly and shortleaf pine, sweetgum, beech, laurel oak, and mimosa occur on the high slopes and bluffs along the river. The largest of these trees are about 70 feet in height and 2.5 feet in diameter. Various shrubs, vines and brambles occur as understory vegetation. Significant stands of marketable pine timber are absent. The lower banks of the river are sparsely vegetated wetland margins. They range in width from a few feet to approximately 20 feet in areas where the bluffs behind are seriously eroding. They are of little ecological significance because of their poor habitat quality.

The wildlife resources of the study area are limited by the proximity of cities of Tuscaloosa and Northport. The most common big game animal typical of the central Alabama region is the whitetail deer. Wild turkey also occurs in the region. Large populations of either are unlikely in the study area since they prefer mature forests with an open understory and

interspersed crown openings which is atypical of the study area. Other game species common to the region include fox and gray squirrels, eastern cottontail rabbit, swamp rabbit, bobwhite quail, and mourning dove. There are also numerous species of nongame animals represented. Actual wildlife use of the study area, including the downstream areas and disposal areas is extremely limited because of the proximity of various industries, the airport, and other urban areas with high human use.

4.3.16 Threatened and Endangered Species: It has been determined by the US Fish and Wildlife Service that the endangered American alligator (Alligator mississippiensis) occurs in the vicinity of the project area where there is appropriate habitat. However, due to lack of appropriate habitat in the actual study area, this species is not likely to occur. No other endangered or threatened species are expected to occur in the study area.

4.3.17 Air Quality: In accordance with the requirements set by the Clean Air Act Amendments of 1977, the Alabama Air Pollution Control Commission (AAPCC) has classified each county within the State in terms of National Ambient Air Quality Standards (NAAQS). Tuscaloosa County has been designated an attainment area for all of the pollutants which are measured as part of NAAQS (oxidants (ozone), carbon monoxide, nitrogen dioxide, sulfur dioxide, suspended particulate matter, and hydrocarbons), which means it has equal or better air quality than that designated by the standards. Since Tuscaloosa County is an attainment area it must also receive a designation under the Prevention of Significant Deterioration (PDS) regulations. It has been designated as a Class II Area which provides limits on allowable increases in concentrations of particulates and sulfur dioxide. Though only particulates and sulfur dioxide are measured in Tuscaloosa County, the AAPCC believes that emission sources are minor and do not contribute to a pollution problem in the county (bureau of Land Management, 1978).

4.3.18 Water Quality: Table EIS 2 presents water quality data collected in Oliver Pool and tailwaters between July 1978 and October 1979 at three

Table EIS 2. Ranges of water quality parameters measured at four locations in the vicinity of Oliver Pool, July 1978 to October 1979.[1/]

Location	Parameter			
	Dissolved Oxygen (mg/1)	Temperature (°C)	pH	Conductivity (umho/cm)
Holt Lock & Dam tailrace	5.4 to 9.6	7.5 to 29.0	6.50 to 6.90	150 to 240
U.S. 82 Bypass	5.5 to 9.6	7.0 to 29.0	6.62 to 7.09	130 to 260
U.S. 82	5.5 to 14.0	7.0 to 29.5	6.62 to 7.38	130 to 260
Oliver Lock and Dam tailrace	6.6 to 10.6	10.0 to 29.0	6.20 to 7.40	155 to 210
Water Quality Criteria[2/]	5.0	-15.0 to 32.2	6.00 to 8.50	No guidelines

1/ Measurements were taken at the water surface using a HYDROLAB SURVEYOR MODEL 6D.
2/ From AWIC, 1978.

SOURCE: US Army Corps of Engineers, 1979 and US Army Corps of Engineers, 1980.

R/12/83

locations above Oliver Lock and Dam and one location below Oliver Lock and Dam: (1) The Holt Lock and Dam discharge (RM 346.8), (2) 100 feet above U.S. 82 bypass (RM 341.4), (3) 100 feet above U.S. 82 (RM 338.9) and (4) below Oliver Lock and Dam (RM 336.6).

Historically, the Black Warrior River in the vicinity of Tuscaloosa has had a water quality problem. The cities of Tuscaloosa and Northport, and a variety of industrial establishments have contributed significantly to the pollution load of the river in the past with extreme periods of zero dissolved oxygen present in the river. Due to the closing of several major industries and the implementation of stricter State pollution control standards, water quality has improved. During the course of the contract studies presented here, water quality parameters have remained well within the State water quality criteria.

Little sediment analysis data is available for the river bottom in the study area. It is reasonable, however, to assume that most contaminants that reach Oliver Pool settled out due to the tranquil nature of the impoundment. The sediments downstream of the dam should be of fairly good quality. Disturbances to the sediments and release of any contaminants would therefore be insignificant. Most of the earth work done in conjunction with the new dam will be done "in the dry" or within cofferdams using earth moving equipment. This material will be placed in a contained upland site. Runoff protection within the disposal area will be provided by construction of a small dike around the disposal area to trap sediments. Drainage outlets will be provided as needed to control damage to adjacent properties. The dike will be grassed to control erosion. When the disposal area is filled and the outside perimeter is protected with grasses, vines, and shrubs, the small dike will become part of the disposal area.

4.3.19 Erosion: The river channel in the study area extending approximately one-half mile below the existing dam has erosion problems along portions of its banks. The river banks are presently riprapped in some areas to provide protection to the banks and bluffs behind. However, other areas are bare, unvegetated, or sparsely vegetated. Backing the immediate

river banks are high bluffs. Some portions of these bluffs are stabilized with vegetation and other portions are exposed and unvegetated. Since soils are held in place by vegetative cover and its associated root system, the absence of this cover exposes the soil to the erosive forces of wind and water. These bluffs are particularly vulnerable during high water when water levels and increased water velocity act together to cause sloughing of the bluff on both river banks. The medium and fine textured soils of the study area are generally more susceptible to erosion than coarse grained sediments. Erosion and sloughing of these steep, exposed banks can be expected to continue occurring until the slope of the bank reaches an equilibrium which reduces the erosion potential or until preventive measures are taken.

4.3.20 Benthic Community: The composition of a benthic community can serve to identify stream conditions in an area. Because aquatic communities are a result of past and existing conditions, the community structure and diversity reflects water quality changes that may have previously occurred. During a short-term exposure to water of poor quality, organisms which cannot tolerate the stress are often destroyed and the aquatic community structure changes. The presence of organisms known to be tolerant to many pollutants does not necessarily indicate pollution problems since those same organisms may be found in either clean or polluted situations. However, a population of tolerant organisms combined with an absence of intolerant organisms is a good indication of the presence of water quality problems. A healthy stream system will normally support a highly diverse community while a stressed system will generally support a community showing little diversity. Results of the Water Quality Management Study conducted in Oliver Pool show a benthic community composition of very little diversity. Samples taken from August 1978 to December 1978 found that at least 90% of the organisms collected were dominated by Oligochaeta, Pelecypoda, and Chironomidae. Habitat availability is a major cause of low diversity in a situation such as Oliver Pool. The conversion of the Black Warrior River to a reservoir situation created a bottom environment with few available niches which limits the types of organisms which can adapt. Increased water depth caused decreased light penetration to the bottom.

The muddy unoxygenated, or poorly oxygenated, substrate resulting from these changes provides habitat for only those organisms which can tolerate substrate conditions of low oxygen, such as those that exist in Oliver Pool.

4.3.21 Fishery: The Black Warrior River supports a diverse assemblage of freshwater fishes. Approximately 110 species of warm water fishes are known to occur in the system. Species diversity within the study area does not approach that of the system as a whole but many species of fish utilize the area. Some 18 species of sport and commercial fishes are known to occur in the area as well as many other forage and nongame species.

Species diversity and population levels of fishes in the study area are controlled by a number of factors. Species in the main stem of the river are limited to those adapted to a slow-moving reservoir system. Fishes typical of this area include bluegill, largemouth bass, spotted bass, white crappie, channel catfish, blue catfish, longnose gar, and shortnose gar in addition to many forage species. The gizzard shad is typically abundant in a reservoir system. Species more typical of a fast-moving riverine system are generally restricted to tributary streams not directly influenced by water-level manipulation. Fishes typical of this system include bluegill, longear sunfish, green sunfish, spotted bass, and many species of minnows (Cyprinide) and darters (Percidae).

4.3.22 Cultural Resources: As discussed in Paragraph 1.3.1 a Cultural Resources Reconnaissance has been performed of the proposed project area. The results of that study indicated that there are ten cultural resources sites potentially eligible for the National Register of Historic places within the immediate vicinity of the study area. These archaeological sites represent the remains of human habitation beginning at approximately 10,000 years ago. Given the potential importance of these resources it will be necessary to conduct further investigations to determine their potential for contributing scientific information.

5.0 IMPACTS OF ALTERNATIVES (TABLE EIS 3): A comparison of the economic benefits and costs for each alternative is given in Table 10 of the main report.

5.1 Land Use: There will be no land use change associated with the no-action alternative. Acreages required for lock and dam construction and disposal of excavated material for each construction alternative are shown in Table EIS-4. Appendix A, Charts III-1 to 4 show the locations of the affected lands. Land-use changes as a direct result of the lock and dam replacement will be confined to these areas. Relocation of the golf course will be the major land-use change occurring as a result of the project. For alternatives 1, 3, and 4, lands are available on the western edge of the present golf course limits for relocation. For alternative 2 lands that will be vacated by the present lock and dam facility may be available to conversion into the golf course. The proposed disposal areas are presently undeveloped, however, they have been designated for future industrial development by local development plans. It is likely that this land will continue to be suitable for such use after the completion of construction.

The addition of hydropower to any of the alternatives will cause similar impacts. The major impact of the addition will be the increased project lands which would be required for generating facilities. Transmission line development will result in habitat changes such as the loss of forest lands. The right-of-way for the transmission lines would tie into an existing power line located south of the project. It would follow a cleared gas transmission line located near the project site in order to minimize the amount of land clearing required.

5.2 Community Cohesion: There will be no changes in community cohesion with alternatives 1, 3, 4 and the no-action alternative. Alternative 2 may have a negative impact on community cohesion by disturbing adjacent residential neighborhoods because access to the study area for alternative 2 would be via a road on the left bank which runs through a residential subdivision of single family dwellings. If this access is used during construction, heavy machinery and equipment would disturb the neighborhood with noise and possible safety hazards.

Table EIS 3

Comparative Impacts of Alternatives

Significant Resources / Alternatives	Land Use	Community Cohesion	Community Growth	Housing	Employment	Displacement of People	Public Facilities	Public Services	Transportation	Property Values	Tax Values	Noise	Leisure Opp.	Aesthetics	Riparian Environment	Water Quality	Air Quality	Erosion	Benthos	Endangered and Threatened Species	Cultural Resources
(1)a. Existing dam, new larger lock landward	-SL	-SL	NC	NC	+MS	NC	NC	NC	+SL	NC	-ML	-SS	-SL	-SS	-SL	-MS	NC	+SL	-ML	NC	-SL
(1)b. Same as above with addition of hydropower	-SL	-SL	NC	NC	+ML	NC	NC	+SL	+SL	NC	NC	-SS	-SL	-SS	-SL	-MS	NC	+SL	-MC	NC	-SL
(2)a. New lock and fixed crest dam downstream	-SL	-SS	NC	NC	+MS	NC	NC	NC	+SL	NC	NC	-SS	-SL	-SS	-SL	-MS	NC	+SL	-ML	NC	-SL
(2)b same as above with addition of hydropower	-SL	-SS	NC	NC	+ML	NC	NC	+SL	+SL	NC	NC	-SS	-SL	-SS	-SL	-MS	NC	+SL	-ML	NC	-SL
(3)a. Existing dam, gated spillway, new larger lock	-ML	NC	NC	NC	+MS	NC	NC	MS	+SL	NC	NC	-SS	-SS	-MS	-MS	-MS	NC	+SL	-ML	NC	-SL
(3)b. Same as above with addition of hydropower	-ML	NC	NC	NC	+ML	NC	NC	+SL	+SL	NC	NC	-SS	-SS	-MS	-MS	-MS	NC	+SL	-ML	NC	-SL
(4)a. Existing dam, combination spillway, new larger lock midstream	-ML	NC	NC	NC	+MS	NC	NC	NC	+SL	NC	NC	-SS	-SS	-MS	-MS	-MS	NC	+SL	-MC	NC	-SL
(4)b. Same as above with addition of hydropower	-ML	-NC	NC	NC	+ML	NC	NC	+SL	+SL	NC	NC	-SS	-SS	-MS	-MS	-MS	NC	+SL	-ML	NC	-SL

\- - Negative Impact
\+ - Positive Impact
MS - Minor, Short-Term Impact
ML - Minor, Long-Term Impact
SS - Significant, Short-Term Impact
SL - Significant, Long-Term Impact

NI - No Impact
NC - No Change
CD - Cannot Be Determined
1 - No Change Meaning Continued Erosion
2 - Assuming Protective Measures are Undertaken
* - Recommended Plan

Table EIS 4. Acreages of Cleared Areas and Disposal Areas, and Amount of Disposal Material Required for Each Alternative.

Alternative		Cleared Area (acres)	Disposal Area (acres)	Disposal Material (CY)
1a.	Existing dam, new larger lock landward,	107.5	174.0	5,614,600
b.	Same as above with addition of hydropower,	125.4	194.0	6,244,200
*2a.	New lock downstream and fixed crest dam	81.0	134.0	4,307,300
b.	Same as above with addition of hydropower,	90.8	139.0	4,498,000
3a.	Existing dam, new larger lock midstream, gated spillway,	46.8	98.0	142,500
b.	Same as above with addition of hydropower,	57.3	98.0	3,142,500
4a.	Existing dam, new larger lock midstream, combination spillway,	51.9	60.0	1,923,600
b.	Same as above with hydropower, and	60.0	80.0	2,553,200
5.	No Action	0	0	0

* Selected plan

5.3 Employment: There will be no effects on employment for the no-action alternative. The remaining alternatives will have short-term effects due to the need for construction employees. The alternatives which include the addition of hydropower, will involve the largest man-day work requirements and will provide for five additional permanent personnel for operation and maintenance of the lock, dam, and powerhouse.

5.4 Transportation: The no-action alternative will not respond to the needs of river traffic. The capacity of the BWT system will continue to be limited by Oliver Lock and traffic delays will continue to occur. The remaining alternatives, both with and without the addition of hydropower, will alleviate the delays at Oliver Lock making it commensurant with the rest of the river system. Alternative 1 will require the relocation of a portion of the Gulf Mobile and Ohio Railroad to the upland side of the new lock. The proposed relocation area is presently an open grassed area part of which is currently used for the golf course. Temporary delays in rail traffic over this track may occur during construction activities.

5.5 Tax Values: Lands which are converted to Federal project lands would become non-taxable by the City of Tuscaloosa which would lessen their overall revenues collected.

5.6 Noise: There will be no long-term changes in existing noise levels associated with any of the alternatives. Short-term increases in noise levels during construction will occur for all but the no-action alternative. Noise associated with construction will persist longest if the hydropower alternative is developed. Noise increases should remain localized during construction. Blasting to remove all or portions of the existing dam will provide intense short-term disturbances in all but the no-action alternative. Implementation of noise specifications as required by law will serve to keep noise levels within tolerable limits.

5.7 Leisure Activities: The no-action alternative have no affect on leisure activities. Alternatives 3 and 4 with a new larger lock near the middle of the dam with and without the hydropower addition would have no

long-term adverse effect on the use of the Tuscaloosa golf course. The remaining alternatives utilize portions of the golf course as part of the project lands. It appears there are available lands to relocate those portions of the golf course which are destroyed. Alternative 2 would cause lands on the existing project site to be abandoned. It is possible that those lands could be developed for use by the country club.

Construction activities for alternatives 1 through 4 will have a negative short-term impact on all the recreational activities occurring at the existing project site. During construction, bank fishing will be reduced or eliminated near the project site for safety reasons and because of disturbance of the fish populations. Sightseeing at the site would also be limited for safety. These impacts will be alleviated after project completion.

A boat ramp downstream from the recommended alternative (alternative 2) has been incorporated into the plan. Although this ramp is being designed primarily for maintenance of the proposed lock, dam, and powerhouse, it will be available for public use.

5.8 Aesthetics: There will be no aesthetic changes associated with the no-action alternative. Construction activities of the remaining alternatives will be visible in the study area. Construction activities for alternatives 1 through 4 will be visible from the Tuscaloosa Country Club golf course on the left bank of the river and from the river to river traffic. The right bank of the river is undeveloped and not widely used, so it would be unaffected by adverse aesthetic changes due to construction. Aesthetic changes due to construction activities would be short-term only. Long-term negative aesthetic impacts due to the construction of a new lock, new lock and dam, or powerhouse would not be serious. The structure of the facilities will not create a visual blight although it will be visible from the Tuscaloosa Country Club golf course and any future development projects on the right bank.

5.9 Riparian Environment: There will be no changes to the riparian environment as a result of the no-action alternative. Table EIS-3 shows the acreage affected for both construction areas and disposal areas for each alternative. Land on the left bank will be permanently changed to project lands as a result of facility construction for all alternatives. Alternative 1 will require a substantial amount of golf course lands. Although these lands do not represent significant losses of wildlife habitat, relocation of these portions of the golf course which are destroyed will most likely be in adjacent forested areas causing a habitat loss. Alternatives 1 and 2 each require substantial amounts of land disturbance (281 acres and 215 acres without hydropower, 319 and 230 with hydropower, respectively) and will affect the sparsely vegetated wetland river margins. Alternative 1 would cause the excavation and inundation of those wetlands located in the construction area of the proposed lock channel.

Alternative 2 would result in the permanent inundation of approximately 1.25 acres of poor quality, sparsely vegetated river margin wetlands. The loss of these areas is not of major ecological significance since they do not presently contribute significantly to habitat quality in the study area. Loss of wildlife habitat to the project lands will be permanent as project lands will continue to be used for operational purposes.

The impacts of alternatives 3 and 4 are similar although alternative 3 impacts more acreage (46.8 and 51.9 acres without hydropower and 57.3 and 60.0 acres with hydropower, respectively).

Disposal land for all alternatives, however, will be allowed to undergo natural succession. Rapid revegetation would first revert to a brush stage dominated by early successional plants which would eventually be replaced by vegetation similar to that which presently exists providing no further disturbance occurs. This area may be developed as an industrial site in the future since it has been designated as a prime development site in the Tuscaloosa area development plan.

All but the no action alternative would result the permanent displacement of animals in the study area. The disposal area would temporarily lack food and cover. However, after revegetation of the disposal lands through natural succession, browse material and cover should be abundant on the disposal lands providing there is no further disturbance due to development.

The addition of a boat ramp at Mill Creek will cause an additional disruption of approximately 40 acres of land which will be used for road construction and the ramp. These lands will be permanently converted to facility lands and be unavailable for wildlife use.

5.10 Threatened and Endangered Species: Since the proposed construction will not impact habitat suitable for alligators, there will be no significant impact on any endangered species by the construction of a new dam.

5.11 Air Quality: No long-term changes in air quality should occur as a result of any of the alternatives. Short-term changes such as elevated exhaust and dust levels due to construction activities may occur in all but the no-action alternatives. There should be no changes in the overall air quality in the vicinity of the project site as a result of the lock and dam replacement.

5.12 Water Quality: The impacts of all project alternatives will be mainly due to construction activities and will be short-term. Increase in turbidity could be expected during construction, although preventive measures will be taken to prevent unnecessary discharge of wastes associated with construction. Long-term changes in water quality would not be significant as a result of any of the lock replacement alternatives.

The addition of hydropower to any of the alternatives would cause similar water quality changes. Because the hydropower plant will be operated as a run-of-the-river facility with no storage in Oliver Pool, the changes in water level fluctuations generally associated with hydropower projects would not occur.

Since the dissolved oxygen (DO) levels in Oliver Pool in recent years have rarely dropped below the state DO standard of 5 mg/l, water quality degradation below the proposed dam is not anticipated. Nevertheless, in an effort to ensure that there is no recurrence of any DO problem, a draft tube aeration device (refer to the section in Appendix A entitled "Plant Design Assumptions") will be installed in the turbine.

Turbidity in Mill Creek may be temporarily increased during construction of the boat ramp. Once construction is complete, however the surrounding area will be stablized using riprap to minimize any additional impacts.

5.13 Erosion: Erosion problems below the existing dam will continue to occur with alteratives 3, 4 and no action.

Alternative 1 would create a lock channel extending approximately one mile downstream. The areas presently prone to erosion would be incorporated into the new the lock channel and dam. Appropriate erosion protection measures of those areas adjacent to the lock and lock channel would have to be undertaken to avoid continuing erosion.

Alternative 2 would raise the water level behind the new dam to an elevation of approximately 123 NGVD during normal pool elevations which is approximately 28 feet higher than the present 95 NGVD in the lower river reach. This would inundate an additional 23 acres of land. The eroding areas would be riprapped and stablized to avoid a continuing erosion problem.

5.14 Benthic Community: The benthic organisms in the study site would be affected by all but the no-action alternative. Alternatives 3 and 4 with a new lock midstream would disrupt benthic communities during construction by disturbing the bottom habitat. After project completion, however, benthic recolonization will be able to occur. Alternative 2 would involve a permanent loss of .41 acres of river bottom due to the construction of a new dam. The construction of a new lock and lock approach both at the existing

dam and downstream will provide additional river bottom habitat for colonization by benthic organisms. The low diversity of benthic invertebrate presently inhabiting Oliver Pool is not likely to change as a result of any of the project alternatives.

5.15 Fishery: The turbines to be installed in the power plant will have vertical Kaplan type runners with adjustable pitch blades and operate at a speed of approximately 106 rpm. This arrangement will allow sufficient clearances between runner blades that will minimize physical and pressure inflicted damage to fish passing through the hydroelectric conduit while allowing optimum fish passage. Larger fish, due to their increased swimming ability, are expected to avoid the intake structure by detecting the intake current.

Mortality to fish passing through turbines at hydroelectric facilities is generally a result of three phenomena. These phenomena are shearing action during passage through the turbine and conduit, the striking of fish by moving blades and the direct contact of fish with rigid parts of the equipment and cavitation. The type of turbine to be used and its operation characteristics, should optimize survival of those fish that pass through the turbines at Oliver Lock and Dam. Because of the large clearances of a Kaplan turbine, there is probably little opportunity for direct mechanical damage to fish within the wheel. The low design runner speed (approximately 106 rpm) chosen for the turbines also enhances fish survival. Negative pressure effects will be avoided by setting the turbine runners at a favorable elevation relative to the tailwater elevation. This will avoid local negative pressures that would cause cavitation and the resultant blade destruction and increased fish mortality.

The absolute number of fish expected to pass through the turbine intake is unknown, although it is believed that the area immediately above the intake is not an optimum fish habitat. The fish population in the Black Warrior-Tombigbee Rivers is essentially nonmigratory; therefore, few individuals are likely to pass through the turbines. Research referenced in Alabama Electric Cooperatives' application for License at the Demopolis Lock and

Dam suggests that 89 percent and greater survival can be realized during fish passage through Kaplan turbines. Since the number of fish passing through the turbines at Oliver Lock and Dam is expected to be small and survival is relatively high, no significant adverse impact on the fishery of the river will occur.

5.16 Cultural Resources: As discussed in Paragraphs 1.3.1 and 4.3.21 ten potentially eligible cultural resources have been discovered within or in close proximity to the study area. Alternatives 1 through 4 may affect five cultural resources. Table EIS-5 presents the cultural resources and actions which may impact them. The remaining five potentially significant cultural resources are located within the study area but would not be impacted by the proposed alternatives.

Table EIS 5. Impact of Alternative Plans on Cultural Resources

Resource	Impacts of Alternatives					
Site No.	Alternative					
	1	2	3	4	Disposal Site	Boat Ramp
1Tu264	x	x	x	x	x	
1Tu265		x	x		x	x
1Tu266		x				
1Tu421	x	x	x	x		
1Tu423	x	x	x			
1Tu427						
1Tu432						
1Tu436						
1tu444						

NOTE: 'x' indicates that the resource site will be impacted by the corresponding alternative or action.

Each resource listed in Table EIS-5 will require further investigations if it will be impacted by the proposed action. These resources would necessarily require archaeological testing and further coordination with the Alabama State Historic Preservation Officer, the National Register of Historic Places, and the Advisory Council on Historic Places, as appropriate, according to current Federal Law and Corps of Engineers regulations.

6.0 List of Preparers. The following people were primarily responsible for preparing this Environmental Impact Statement:

Name	Discipline/ Expertise	Experience	Role in Preparing EIS
Ms. Carol Gorbics	Biology/General, Aquatic	2 year, EIS studies, Mobile District; 3 years, biological assistant, Coastal Eng. Research Ctr., Corps of Engineers.	EIS Coordination
Mr. Thomas Lightcap	Engineering/ Environmental	10 years, EIS Studies, Mobile District.	EIS Coordination
Mr. Jack Mallory	Biology/Ecology	12 years, EIS Studies, Mobile District; 3 years, Fishery Biologist, USFWS; 5 years, Marine Biologist, State of Alabama; 1 year, mosquito control, Mobile County.	Threatened and Endangered Species Effects
Mr. Robert Meader	Engineering/Civil, Water Resources	7 years, Civil Engineer, Mobile District.	Study Manager, Formulation of Alternatives, Assessment of Needs
Dr. Charles Moorehead	Historian	5 years, cultural resource management, Mobile District.	Cultural Resource Effects

7.0 PUBLIC INVOLVEMENT

7.1 Public Involvement and Coordination

The study for replacement of Oliver Lock has been interrupted several times since it began in 1969. There have been two formal public meetings concerning the proposed replacement. The first was held on 19 May 1970, in Tuscaloosa, Alabama. It was the initial public meeting designed to expose the problems and opportunities for complete comprehension of the needs. Overall, the 37 statements received in response to the public notice were in favor of replacing the lock. The second was held on 28 March 1974, also in Tuscaloosa, Alabama. The basic options were presented for discussion at this public meeting. An environmental assessment was contained in the notice of the meeting. The need for hydropower, another bridge across the Black Warrior, water quality, water quantity, and flood protection were discussed. The option of a replacement lock and dam located about 2,700 feet downstream of the existing project was supported by most of the waterway users during their presentations and prepared statements.

The Warrior-Tombigbee Development Association has been kept fully informed as the study progressed and their support in collection of traffic data and user-defined constraints has been very helpful. Several meetings with the membership have been in the Mobile District Office and in the field to discuss user needs such as mooring facilities, quicker response to maintenance dredging, and other items. The District Engineer participates regularly as a speaker or panel member at the Association's annual meeting. Of special importance to this report was a meeting between the Alabama Congressional Delegation, members of the Association and members of the Corps which was held in Washington during the fall of 1980. It was decided at that time to prepare an interim report on the replacement of the Oliver Lock.

The following paragraph lists recipients of the draft interim report. Comments and responses to comments appear in Appendix D, Section V.

7.2 Statement Recipients

Advisory Council in Historic Preservation
Department of Agriculture
    Agriculture Stabilization and Conservation Service
Forest Service
    Regional Forester
Rural Electrification Administration
Soil Conservation Service
Department of Commerce
Department of Energy
    Federal Energy Regulatory Commission
Environmental Protection Agency
Federal Emergency Management Administration
Federal Maritime Commission
Department of Health and Human Services
Department of Housing and Urban Development
Department of the Interior
Department of Transportation
    U.S. Coast Guard
    Federal Highway Administration
    Federal Railroad Administration
Other interested parties

8.0 References

Alabama Water Improvement Commission, 1978, Alabama Water Quality Criteria

Bureau of Land Management, 1978, "Baseline Study of the Climate and Air Quality of Fayette, Walker, Jefferson, and Tuscaloosa Counties Alabama," report submitted for Contract Number 1-022-03-080-62, Tuscaloosa Office.

McClure, Nathaniel DeHass, IV, 1967, "A Historical Development and Prediction of the Future Water Quality in the Black Warrior River in the Vicinity of Tuscaloosa, Alabama," Masters Tuesis, University of Alabama, University, Alabama.

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APPENDIXES

APPENDIX A

ENGINEERING DESIGN AND COSTS

SECTION I HYDROLOGY AND HYDRAULICS

SECTION II GEOLOGY

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Engineering Design and Costs

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APPENDIX A

SECTION I

HYDROLOGY AND HYDRAULICS

Hydrology. Oliver Lock and Dam is located on the Black Warrior River at Tuscaloosa, Alabama shown on Figures 1, 2, and Chart I-1. The headwaters of the Black Warrior River rise in Northern Alabama. The Tennessee River Basin is north of and adjacent to the Black Warrior River Basin. The average normal annual rainfall of 53.79 inches is usually well distributed throughout the year. The wettest year of record is 1929 with an average annual rainfall of 81.41 inches over the basin and the driest year occurred in 1904 with an average of 41.60 inches. Basin runoff averages 22.31 inches or about 41 percent of the average rainfall. Mean unit flows average about 1.64 cubic feet per second (c.f.s.) per square mile. The mean discharge just above the Oliver L&D at the Northport gage is 7,931 c.f.s. for 59 years of record with a drainage area of 4,828 square miles. Extreme discharges for the period of record range from a maximum of 272,000 c.f.s. on 13 April 1979 to a minimum of 37 c.f.s. on 23 October 1953.

Estimates of the Probable Maximum Flood (PMF) and the Standard Project Flood (SPF) were taken from the study entitled "Review of Design Features of William Bacon Oliver Dam, Black Warrior River, Alabama," dated 24 January 1969. The peak pool stages for the PMF and SPF have been revised because the rating curve has been updated. Peak inflows, outflows, and pool stages are given in the following table.

FLOOD	INFLOW c.f.s.	OUTFLOW c.f.s.	PEAK POOL STAGE ELEVATION NGVD
PMF	693,100	692,500	161.8
SPF	353,600	353,000	154.0

Hydraulic Data. Discharge hydrographs are plotted on Charts I-2 through I-7 for the period of record at the Northport gage. An annual discharge-duration curve and the July discharge-duration curve for the Black Warrior River at the Northport gage are shown on Charts I-8 and I-9, respectively. The discharge frequency curve at Northport (shown on Chart I-10) was

computed from the systematic record at the gage from 1929-79, using a historic adjustment with the April 1979 flood (272,000 c.f.s.) as the largest for the period dating back to 1874. A generalized skew of zero was adopted for weighing with the station computed skew in accordance with Bulletin 17A, "Guidelines for Determining Flood Flow Frequency." Adjustments were made in the data prior to September 1960 to account for flood control at Lewis Smith Dam which controls 944 square miles of the 4,828 square miles above the Northport gage. HEC computer program "Flood Flow Frequency Analysis, Version date 1 April 1978" was used to make the computations. The first computation resulted in a -0.1 adopted skew. Using the expected probability curve from this computation, the 1979 record flood would have a return interval greater than 200 years. Although the lowest annual peak (1967) was not a low outliner by Bulletin 17A criteria, it was removed from the data to check the effect on the skew. This condition gave a positive skew of 0.2. The 1979 flood is between a 100 and 200 year flood on the expected probability curve which was felt to be a more reasonable estimate. This curve was, therefore, adopted for use in this study.

The constant discharge headwater and tailwater rating curves for the existing lock and dam are shown on Chart I-11. The headwater curve was transferred to the existing damsite from the Northport gage located 0.35 mile upstream of the dam. The tailwater curve was estimated using discharge measurements and USGS computer backwater profiles. Shown on Chart I-12 are tailwater rating curves which show estimates of the loop stage effect caused by flood water entering and leaving overbank storage downstream of the dam. Chart I-13 shows design headwater and tailwater rating curves for the replacement lock, dam, and spillway at the existing damsite. Chart I-14 shows headwater and tailwater rating curves 2,700 feet downstream of the existing damsite. The tailwater curve for the existing dam was transferred downstream with the aid of backwater computations. The headwater rating curves were computed for the alternatives spillways in accordance with the latest hydraulic design criteria as described elsewhere in the report.

Restoration of Existing Lock. It is estimated that rehabilitation of Oliver Lock and Dam would prevent passage of river traffic for 10 months. Approximately 6,500 yards of concrete would be replaced, new miter gates installed with the necessary equipment, new tainter valves and related machinery, new hydraulic, electrical and compressed air systems among other repairs would be necessary for the lock. In addition, mooring cells would be added both up and downstream of the lock.

The existing Oliver Lock is a 460- by 95-foot lock with miter gates. The filling and emptying system consists of a 11- by 11-foot culvert in each wall with a 4-port intake manifold on each of the upper lock walls, 23 chamber wall ports on each wall, an 8-port discharge manifold on each side of the river wall and a 16-port discharge manifold on the land wall. The upper guide wall and lock walls have a top elevation of 140.0. It is not proposed to modify the hydraulic characteristics of this lock if it were left in service.

The existing Oliver Spillway is a 700-foot long concrete ogee fixed crest at elevation 122.9. There is a right bank overflow dike at elevation 140.0 and water flows over the top of the lock wall on the left bank at elevation 140.0. This spillway would not be modified if the plan for upgrading the existing lock or the plan for providing a replacement lock in the left overbank were selected.

Replacement Lock and Existing Dam. A new larger size lock located on the landward side of the existing lock would require excavation of approximately 5,600,000 yards of material for the lock and approaches. The 110- by 600-foot chamber would be compatible with the remaining locks on the system. The Tuscaloosa Country Club would be disrupted to the point of probably discontinuing operations. It is also likely that the Illinois Central Gulf Railroad bridge will require relocating to permit access to the lock from upstream. The railroad spur would require relocating to the landward side of the new lock. Possible road realignments may be necessary if River Street has been joined with 32nd Avenue.

Replacement Lock and Spillway at Existing Site. The existing lock and spillway could be replaced with a new 600-foot by 110-foot lock riverward of the existing lock with a gated spillway replacing the fixed crest spillway on the right bank side of the river. This alternative is less feasible from the foundation engineering aspect than the replacement dam downstream, but provides lock approaches that are excellent without railroad relocations. This plan would provide the least disruption to adjoining topography and facilities with 3,100,000 cubic yards of material to be excavated for the spillway approach and exit.

Replacement Lock and Dam Downstream. Three downstream sites for a dam were investigated during the early 1970's. The sites located 13,700 and 8,000 feet downstream had poorer foundation conditions than the site located at 2,700. Rock slopes downward from Oliver Lock so that the sites further downstream require greater excavation. Therefore, the site examined in greatest detail was located just 2,700 feet downstream from Oliver.

A site 2,700 feet downstream of the existing lock and dam was chosen mainly for foundation reasons with consideration for ease of navigation during construction. The three alternative spillways considered with the replacement lock at this site are a fixed crest spillway, a gated spillway and a combination gated and fixed crest spillway. The spillways were sized for a discharge capacity which would produce a maximum swellhead of one foot on the left and right bank overflow dikes when they overtop and start passing flow. All the spillway designs provide for a normal upper pool at elevation 123.0 and are located between the replacement lock on the right bank side and the powerhouse on the left bank side.

Slightly different amounts of material are required to be excavated, depending on which spillway option is selected. A fixed crest spillway will require about 1,013,000 yards to be removed while the gated spillway requires only about 890,000 yards and the combination requires about 1,059,000 yards.

The 110 by 600-foot lock would be located on the right (north) bank of the river and regardless of the spillway option, the amount of material necessary to be excavated would be 3,294,000 cubic yards.

Gated Spillway Alternative. The gated spillway, which could be used at the replacement lock and dam at the existing site or at the site 2,700 feet downstream, consist of seven 60-foot wide by 21-foot high gates with eight 8-foot piers for a total spillway length of 484 feet. The spillway sill is set at elevation 103.0. The top of gates are at elevation 124.0 providing 1 foot of freeboard above normal pool. The approach to the broad crested spillway sill will be excavated to elevation 98.0, providing a minimum of 5 additional feet of depth for flow approaching the spillway to lower hydraulic losses in the approach. The downstream quadrant of the spillway crest will conform to the equation $X^2 = 40Y$ which has been proven to be effective in model studies for this type spillway. It is considered that a stilling basin will be required for the gated spillway because of higher unit discharges through the spillway. The basin will be 60 feet long with a sloping end sill and bottom at elevation 75.0.

Fixed Crest Spillway Alternative. The fixed crest spillway which would be used at the site 2,700 feet downstream has a length of 815 feet with the crest at elevation 123.0. The spillway has vertical upstream face and the downstream quadrant of the ogee crest is defined by the equation $X^{1.85} = 7.85515Y$ and is based on a design head of 5 feet. A stilling basin is not provided because of the sound rock downstream of the crest and because of the high degree of submergence provided by the tailwater. A small flip bucket has been provided at minimum tailwater, elevation 95.0, to reaerate low flows over the spillway. Concrete training walls are provided upstream and downstream of the crest for more effective flow distribution at the abutments.

Combination Spillway Alternative. The combined spillway alternative for the site 2,700 feet downstream is a fixed crest section of spillway 400 feet in length and a gated section of spillway with four 60-foot wide by 21-foot high gates with five 8-foot piers for a length of 280 feet. All

features of these spillways are similar to those described for the respective fixed crest and gated spillways above.

Replacement Lock. The replacement lock would be of similar hydraulic design irrespective of the alternative site selected. The lock chamber gates will be miter gates. The top of the lock chamber walls and upper guide wall will be elevation 148.0. The lock sills were set at a minimum recommended depth of 13 feet. The lock filling system will be a simplified longitudinal floor culvert system with horizontal flow dividers at the wall culverts similar to the Gainesville Lock design. The more costly longitudinal floor culvert system was selected over the side port filling system because of the need for as an efficient a system as possible on this high volume waterway and because foundation conditions would support such a design. The lock floor is at elevation 81.0 allowing 14 feet of submergence below minimum tailwater. The intake manifolds will be located in the upper guide and guard walls. The floor culvert filling system will be fed by 13-foot by 13-foot wall culverts with reverse tainter values for flow control. The only differences in lock design caused by the specific site will be the lock discharge system. For a replacement lock in the left bank land cut at the existing damsite, the discharge manifold will be in the lower guard and guide walls discharging downstream of the lower miter gates. For the replacement lock at all other sites, the discharge will be diverted into a submerged stilling basin in the river.

Launching Ramp. A launching ramp on Mill Creek will provide maintenance crews the opportunity to launch work boats at the lock site. The road to the ramp would be of similar construction as the main access road to the lock having a paved surface width of 30 feet. A turning area at the ramp with dimensions of 60 x 100 feet provides parking as well. The concrete ramp would be on a 15 percent slope and have dimensions of 16 x 50 feet. Mill Creek would be excavated in the vicinity of the ramp to provide depth and turning area for the boats.

Alternative Hydropower Improvements

Nonstructural Measures. The Principles and Standards published in the Federal Register on 14 December 1979 indicated in section 713.601, that small scale hydropower facilities (25 MW or less) did not require comparison to a nonstructural alternative.

Energy Demand. Charts I-15 through I-18 graphically describe the energy demand for the geographical area supported by Alabama Power Company. Chart I-15 is the 1980 annual load curve. It can be seen that the peak demand period is in the summer during the months of July, August, and September. The winter peak demand is about 75% of the summer peak and falls in the months of January and February. Chart I-16 shows the weekly load curve for peak summer demand in July 1980. Chart I-17 shows the weekly load curve for peak winter demand in January and February 1980. Chart I-18 is the load-duration curve for 1980.

As discussed in more detail in the analysis for dependable capacity, a critical month from the standpoint of both loads and hydrologic conditions must be selected. July was selected as that month because it is a low flow month and the peak electrical demand occurs in July.

Powerhouse Siting. A powerhouse option was investigated for each of the alternative sites for lock replacement as shown on Charts III-1 through III-8. For two alternatives, existing lock restoration and replacement lock in the left bank, the powerhouse would be sited in the right bank adjacent to the existing fixed crest spillway. For the alternative of replacement lock in midstream at the existing site, the powerhouse would be sited between the old lock and new lock. For each of the alternatives 1,700 feet downstream, the powerhouse would be located on the left bank on the opposite end of the spillway from the lock.

Hydropower Operational Flexibility. The existing Oliver Lock and Dam has a fixed crest spillway at elevation 122.9. The obvious question in considering a hydropower plant at Oliver Lock and Dam is what can be done with pool storage to increase project operational flexibility and gain hydropower

benefits. With a fixed crest spillway at the existing site or new sites, operational flexibility would lie only below the crest of the spillway. The ability to draw the Oliver Pool down and utilize that storage is not possible because the normal pool at elevation 122.9 provides the required 13-foot sill depth at Holt Lock. With the use of a gated spillway at the existing site or new site, more flexibility could be achieved in operation for hydropower. The gated spillway would allow storage above and below normal pool level to be utilized, but again, the storage below normal pool could not be utilized because the minimum sill clearance of 13 feet must be maintained over the lower sill of Holt Lock. The pool level could be increased in Oliver Pool providing more operational flexibility and additional head for power generation. This would decrease the head available for power generation at Holt by the same amount as the head increase at Oliver and negate that benefit.

Oliver Lock and Dam being downstream of Holt, Bankhead, and Lewis Smith dams, can provide peaking power generation in tandem with the Holt power generation operation. During the time of year which is most critical from the standpoint of both power demand and low flow, upstream releases from Lewis Smith, Bankhead, and Holt will be made to supply power during high demand periods. To that extent, Oliver power production would be much more dependable than a normal run-of-the-river project. The Oliver powerhouse cannot be credited as having the flexibility of storage to provide additional dependable capacity because it is totally dependent on the Holt peaking power generation schedule. However, the additional energy of the flows that would normally be wasted at a run-of-the-river project can be captured at Oliver. For this reason, the providing or not providing of a small amount of power storage is of little significance to the overall flexibility of the power system.

Plant Design Assumptions. The manual "Feasibility Studies for Small Scale Hydropower Additions," published by the Hydrologic Engineering Center and the Institute for Water Resources, was used as a guide in making basic assumptions relative to hydropower capacity and energy outputs. The operating parameters selected were for the variable pitch propeller turbine as

shown in Volume V, Figure 3-9 (vertical Kaplan). It was assumed that the turbine can operate from 60 to 140 percent of the design head and from 40 to 105 percent of the design flow. A draft tube aeration device consisting of an air piping network with air injection ports opening in the draft tube below the turbine runner is planned to insure dissolved oxygen levels in the discharge will be acceptable. Deflector plates would be installed upstream of the air injector ports to increase the suction pressure required to aspirate air into the turbine draft tube. Location and configuration of the deflector plates would be optimized for maximum performance by the application of engineering analysis techniques perfected by the Alabama Power Company. The plant efficiency was assumed to be a constant 86 percent. Capacity and energy computations were made for only two of the alternatives because all of the alternatives produce about the same amount of energy for a given plant capacity. The alternative for the replacement of the lock and spillway at the existing site was selected for hydropower capacity and energy evaluation because it is considered to be the most environmentally attractive plan. The fixed crest spillway alternative at the downstream site was selected because it is the most cost effective plan from a navigation standpoint and produces slightly more average annual energy. (The spillway surcharge provides more head for discharges within the operating range of the hydroplant.)

Losses. Water losses will occur at Oliver due to lockages and leakage. Evaporation losses were not considered in the scope of this analysis. Leakage estimates were based on past experience and on estimates from visual observations at projects of this type. Leakage loss is estimated to be on the order of 25 c.f.s. Lockage losses to hydropower become less as discharge in the river increases. As discharge increases, the headwater/tailwater difference decreases and the quantity of water required for a lockage decreases. In order to obtain conservative values for capacity and energy, the maximum combined lockage loss and leakage loss value of 600 c.f.s. was used for the 600-foot by 110-foot replacement lock.

Capacity. Hydropower plant design capacities were selected for flows which correspond to 15, 23, and 30 percent exceedance values on the annual discharge duration curve after the loss value had been subtracted. The 15 and

30 percent values were arbitrary selections to obtain a good spread of plant capacities. The 23 percent value on the discharge duration curve was selected to provide a powerplant size which could most effectively utilize the flow from peaking power at the best gate setting (8750 c.f.s.) at the Holt project 8.8 miles upstream of Oliver.

The Oliver hydropower plant must come on line at normal upper pool and minimum tailwater or a maximum head of 28.0 feet. This head then corresponds to 140% of design head (H_d) as the upper operating head limitation. The rated head is then 20.0 feet and the lower limit of operation is 12.0 feet correponding to 60% of the rated head. Although 20.0 feet is the rated head for the unit, it may not equate to the net head available for power production at the rated discharge.

Therefore, the maximum plant capacity may not be produced by the rated discharge and head, but by some other critical combination of discharge and head at the specific site for a given turbine. With the variable pitched propeller turbine which can operate from 40 to 105 percent of rated discharge and the tailwater rating curve for constant discharge shown on Chart I-12, the following table summarizes the turbine and generator sizes considered:

Percent Exceedance Value	TURBINE Q rated (CFS)	TURBINE H rated (FT)	CRITICAL COMBINATION Q (CFS)	CRITICAL COMBINATION H net (FT)	PLANT CAPACITY MW
15	12,850	20.0	13,500	16.6	16.3
23	8,750	20.0	9,190	19.7	13.2
30	6,350	20.0	6,670	20.8	10.1(d/s site)
30	6,350	20.0	6,670	20.0	9.7(u/s site)

The plant capacities listed above were computed by the following formula:

$$\text{Plant Capacity} = \frac{QXHXE}{11.8}$$

where: Q = Critical Discharge
H = Net Head Available = Hydraulic Head - 0.75 ft.
E = Plant Efficiency (86%)

Oliver Lock and Dam is a run-of-the-river structure and, as such, would have no dependable capacity under the traditional definition; however, the traditional definition does not allow proper credit for intermittent capacity or that capacity which may be available a substantial amount of the time. FERC-Washington has developed some relationships which make it possible to compute a hydropower plant's capacity benefit considering the hydropower plant's dependable capacity and intermittent capacity and the relative reliabilities of hydropower and thermal capacity.

The equation for determination of dependable capacity is as follows:

$$\text{Dependable Capacity} = \text{CAP X } \frac{\text{HA}}{100} \text{ X } \frac{\text{HMA}}{\text{TMA}} \text{ X } (1+F)$$

where: CAP = Hydropower project's plant capacity
HA = Hydropower project's hydrologic availability (%) during peak load period
HMA = Hydropower plant mechanical availability (%)
TMA = Thermal plant mechanical availability (%)
F = Hydropower plant flexibility factor

Intermittent Capacity = Plant capacity - Dependable capacity

The hydropower project plant capacity is the total capacity output of the generators for a given turbine combination and the hydrologic conditions at that site.

The dependable capacity at Oliver Lock and Dam is intended as a measure of the amount of capacity that can be counted on as being available when needed. As such, dependable capacity will be a reflection of hydrologic availability. Dependable capacity at Oliver has been determined to be the amount of capacity available in the selected historical month (July), which is considered most critical from the standpoint of both loads and

hydrologic conditions. Since Oliver is a run-of-the-river project, the hydrologic availability is simply the plant factor for the month of July as derived from a discharge duration curve for July.

The ratio of the hydropower plant's mechanical availability to the thermal plant's mechanical availability is intended to reflect the relative mechanical reliability of hydroelectric compared to thermal generation. Operating experience indicates that hydro plants are mechanically available about 98% of the time. Based on the type and size generating plants presently being built by Alabama Power Company, the most likely alternative to a hydro plant at Oliver Lock and Dam would be a fossil fuel plant of from 700 to 800 MW capacity. Data published by the Electric Power Research Institute and the National Electric Reliability Council indicates that a fossil fuel plant of that size would be about 77% reliable without considering scheduled maintenance. Therefore, the mechanical availability ratio for Oliver is:

$$\frac{HMA}{TMA} = \frac{98.0}{77.0} = 1.27$$

The hydropower plant flexibility factor is an attempt to take credit for any operating flexibility which may be available to the hydroplant that is not available to the most likely alternative type of generating plant. Since the Oliver Hydroplant will have no daily or weekly storage, this plant will have an inherent inability to respond quickly to demand fluctuations and no flexibility credit is warranted. It can be argued that because of storage in upstream reservoirs, Oliver will have the capability to respond with the demand response of those upstream plants. However, since this is a system capability and not an independent capability of the Oliver plant, no specific flexibility credit should be given to the Oliver plant and this term in the equation drops out.

Dependable Capacities for the plants evaluated are as follows:

Replacement Lock, Gated Spillway, & Powerhouse at Existing Site

Percent Exceedance Value	Plant Cap (MW)	Ave. July PF (%)	DEP CAP (MW)
15	16.3	17	3.5
23	13.2	20	3.4
30	9.7	20	2.5

Replacement Lock, Fixed Crest Spillway, & Powerhouse 2700'D/S of Existing Site

Percent Exceedance Value	Plant Cap (MW)	Ave. July PF (%)	DEP CAP (MW)
15	16.3	17	3.5
23	13.2	20	3.4
30	10.1	21	2.7

Installed Capacity: The installed or nameplate capacity of the generator in the hydropower plant will be equal to the plant capacity only if there is a single unit installed. If more than one unit is installed, each generator would have to be sized such that it could operate alone without overloading. For instance, a single turbine with Q_r=8750 CFS and H_r=20.0 feet would operate with a critical combination of Q=9190 and H=19.7 feet for a required generator capacity of 13.2 MW, but one of two identical turbines with Q_r=4375 and H_r=20.0 feet would operate alone with a critical combination of Q=4590 CFS and H=23.4 feet for a required generator capacity of 7.8 MW for each unit. This would mean you would have an installed capacity of 15.6 MW, but would still only have a plant capacity of 13.2 MW.

Energy. For run-of-the-river type hydropower installations, such as Oliver, the discharge-duration analysis yields best results for estimating average annual energy (AAE). AAE was computed for plants with rated discharges which correspond to the 15%, 23%, and 30% exceedance values on the annual discharge duration curve as shown below:

Replacement Lock, Gated Spillway, & Powerhouse at Existing Site

Percent Exceedance Value	Plant Cap (MW)	AAE (MWH)	Annual PF (%)
15	16.3	40,200	28
23	13.2	36,300	31
30	9.7	27,100	32

Replacement Lock, Fixed Crest Spillway, & Powerhouse 2700 D/S of Existing Site

Percent Exceedance Value	Plant Cap (MW)	AAE (MWH)	Annual PF (%)
15	16.3	43,500	30
23	13.2	39,400	34
30	10.1	30,560	35

The values of AAE were computed by the numerical integration of a capacity curve reflecting available capacity for incremental values of discharges and head within the operating ranges of each plant. The peaking operation of the Holt hydropower plant allows the use of low mean daily flows normally below the operating range of the Oliver hydropower plant to be utilized at a head and flow that is within the operating range.

Hydropower Plant Costs. The manual "Feasibility Studies for Small Scale Hydropower Additions" was used to determine general costs for the three plant sizes at a site 2,700 feet downstream of the existing Oliver Lock. These general costs were escalated from the base year (July 1978) to October 1982 price levels using the U. S. Bureau of Reclamation's Construction Cost Trends. As indicated in the table, costs increase as installed plant capacity increases.

Plant Size	Electro-mechanical Features	Civil Features	Contingencies (25%)	S & A and E & D	Total
10.1	$7,800	$2,400	$2,500	$2,500	$15,200
13.2	8,700	2,400	2,800	2,700	16,600
16.33	9,800	2,400	3,000	3,000	18,200

Chart I-19 graphically portrays this increase as generally linear. These costs will be refined during later feature design memorandums. Details of the costs used in this table can be found in Section IV of this appendix. Chart I-19 also portrays benefits which were developed in the main report and summarized in the following table.

	Plant Size (MW)		
	10.1	13.2	16.3
Power Features 1/	$15,200,000	$16,600,000	$18,200,000
Lands and Damages	600,000	600,000	600,000
Access Roads	100,000	100,000	100,000
Subtotal	$15,800,000	$17,300,000	$18,900,000
IDC	1,800,000	2,100,000	2,200,000
Total	$17,600,000	$19,400,000	$21,100,000
Interest and Amortization 2/	1,400,000	1,600,000	1,700,000
Operation Maintenance and Replacement	300,000	300,000	400,000
Annual Cost	1,700,000	1,900,000	2,100,000
Annual Benefits 3/	1,700,000	2,200,000	2,400,000
Net Benefits	-	300,000	300,000
B/C	1.0	1.2	1.1

1/ Oct 82 price level (assumes dam in place).

2/ 7-7/8% @ 50 years.

3/ Benefits were calculated using FERC 9 May 1983 power values for the coal-fired alternatives.

During review of this report, questions arose as to the cost of transmission lines and the aeration device. Discussions with Alabama Power concerning those items indicated they carried a small price tag. In the case of the transmission lines, the general costs obtained from the manual of $70,000 agreed with figures discussed by Alabama Power for about one-half mile of lines. A cost of $24,000 for installation of a similiar aeration device at Bankhead in 1973 was updated to about $50,000 for October 1982 price levels. The resulting change of about $120,000 was assumed and could adequately be handled by the 3 million dollar contingencies. Accordingly, the above table was not changed nor were the detailed cost tables in Section IV changed.

CORPS OF ENGINEERS

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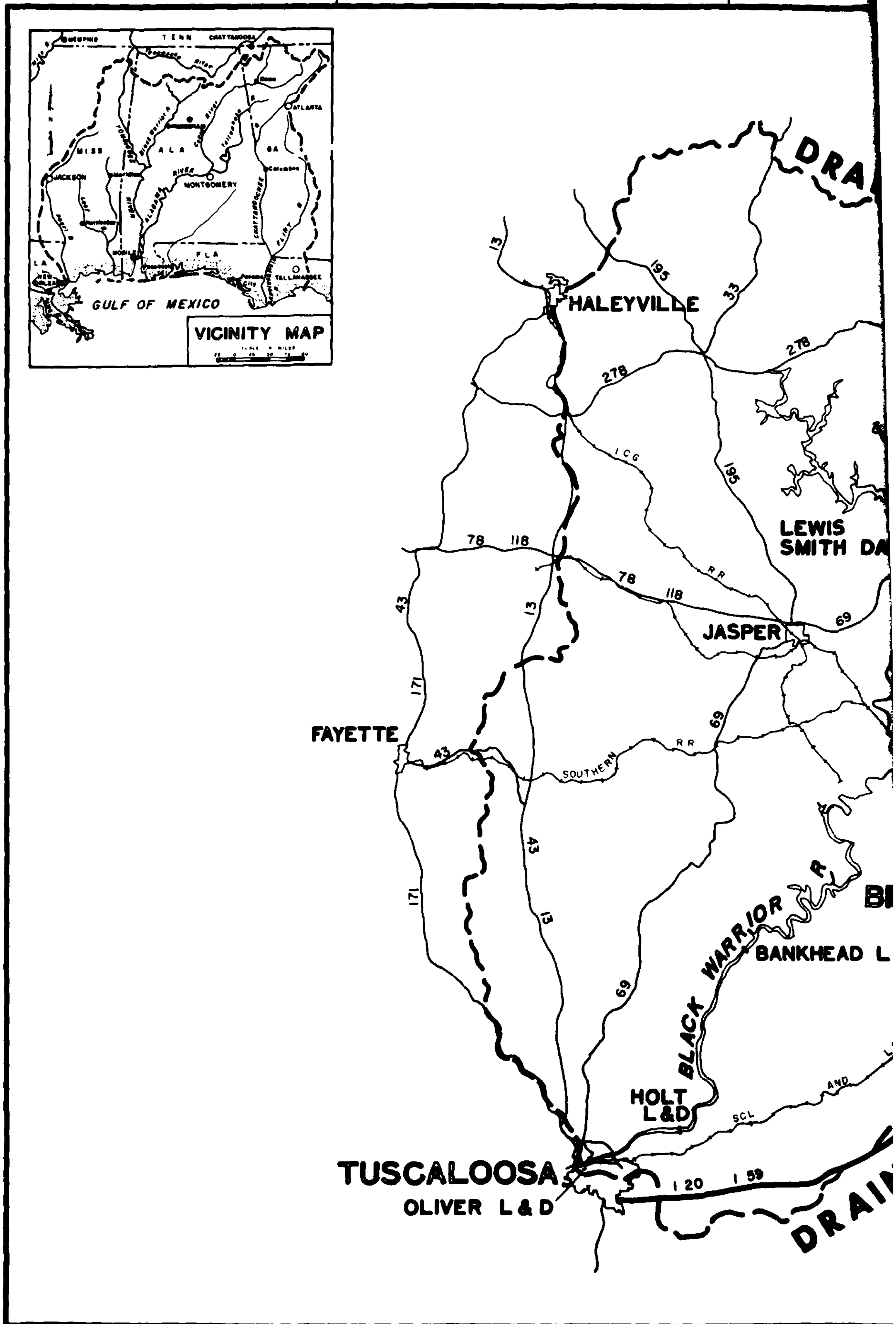

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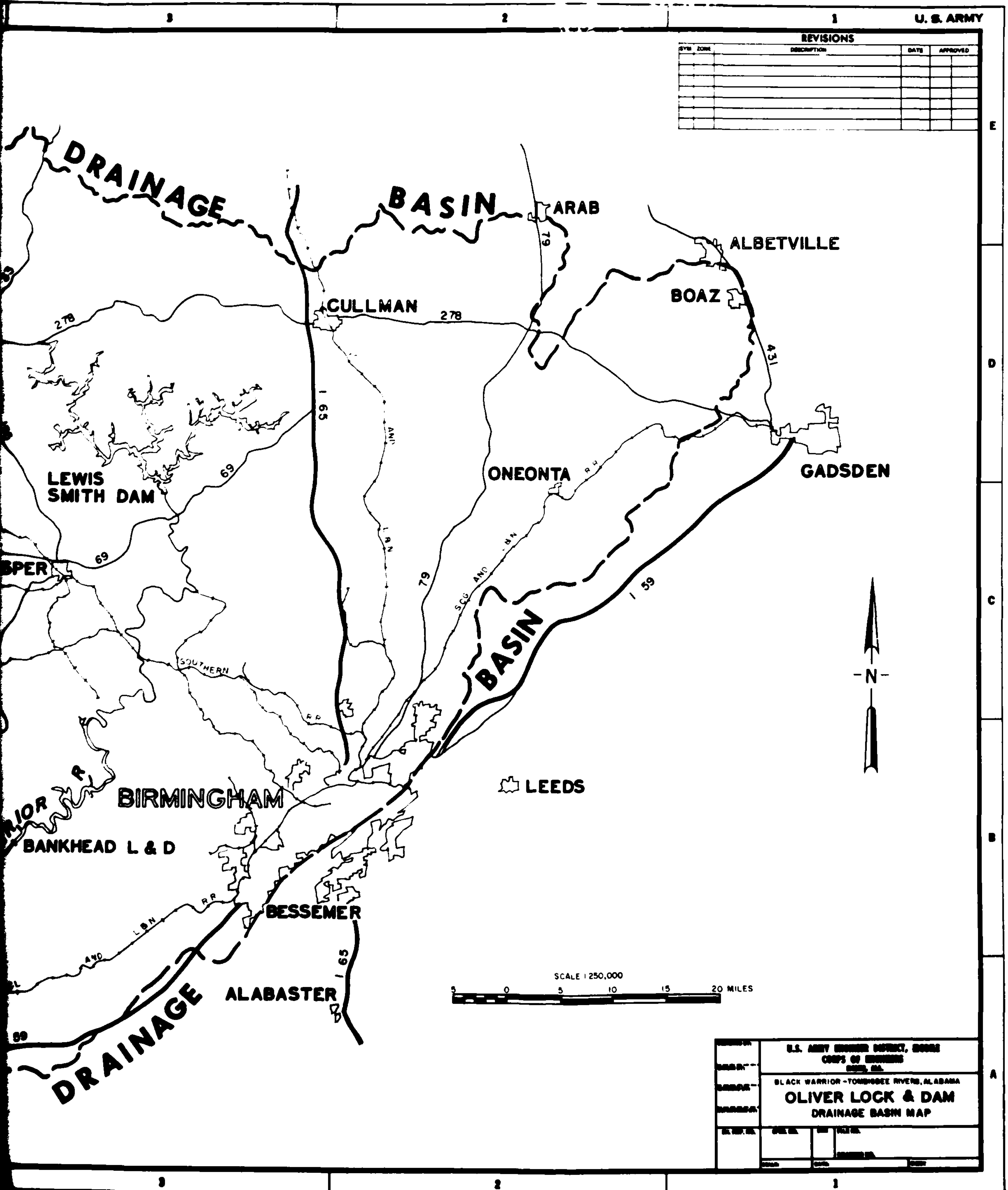
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ONEONTA
GADSDEN
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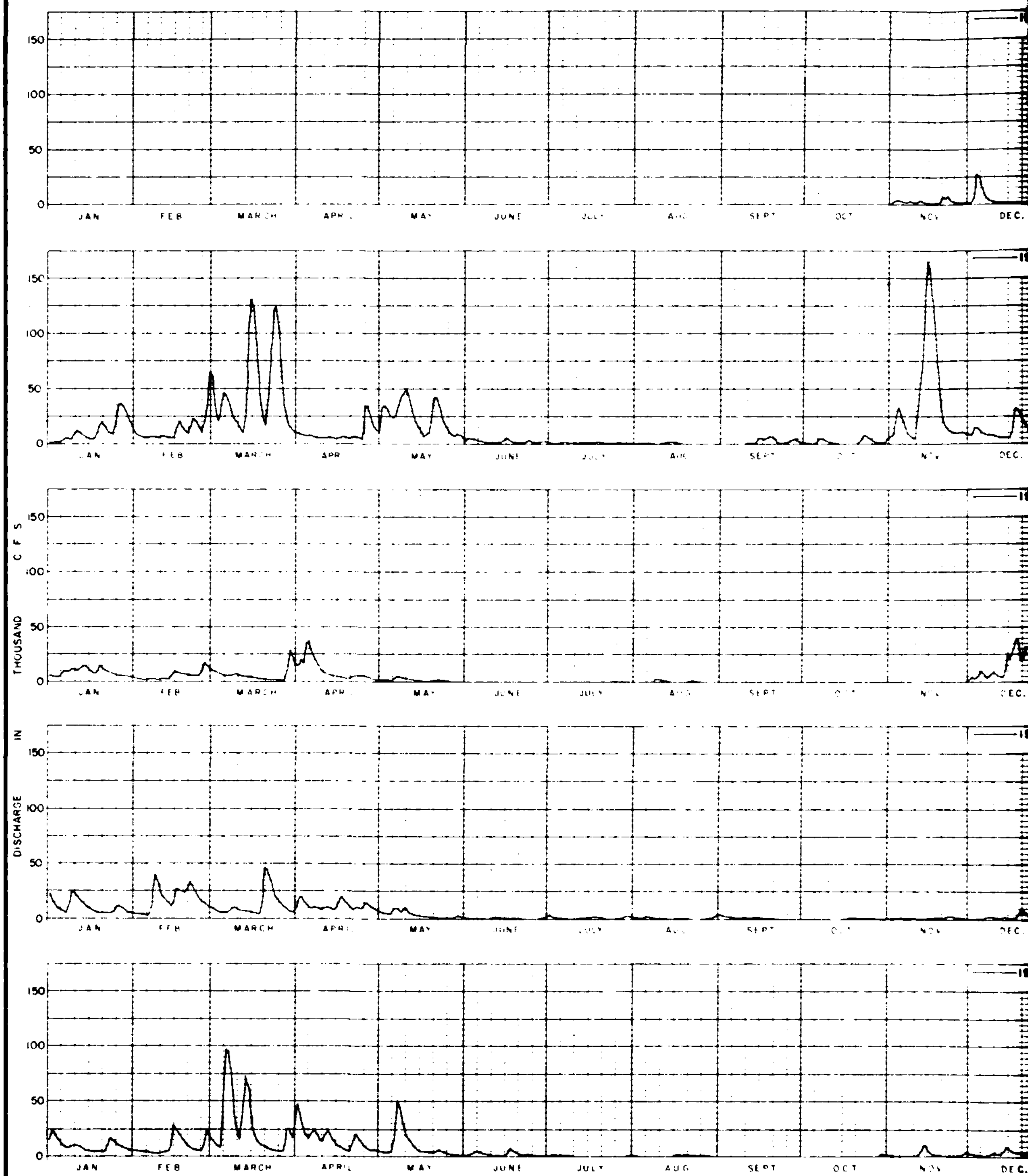
BLACK WARRIOR-TOMBIGBEE RIVERS, ALABAMA
OLIVER LOCK & DAM
DRAINAGE BASIN MAP


DISCHARGE IN THOUSAND CFS
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50
100
150
JAN
FEB
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BLACK WARRIOR - TOMBIGBEE RIVERS, ALABAMA

DISCHARGE HYDROGRAPHS
BLACK WARRIOR RIVER
AT NORTHPORT, AL

2

APPENDIX A, CHART I-2


1937
1939
1941
1943
1945
DISCHARGE IN THOUSAND C F S
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50
100
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JAN
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MARCH
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BLACK WARRIOR - TOMBIGBEE RIVERS, ALABAMA

DISCHARGE HYDROGRAPHS
BLACK WARRIOR RIVER
AT NORTHPORT, AL.

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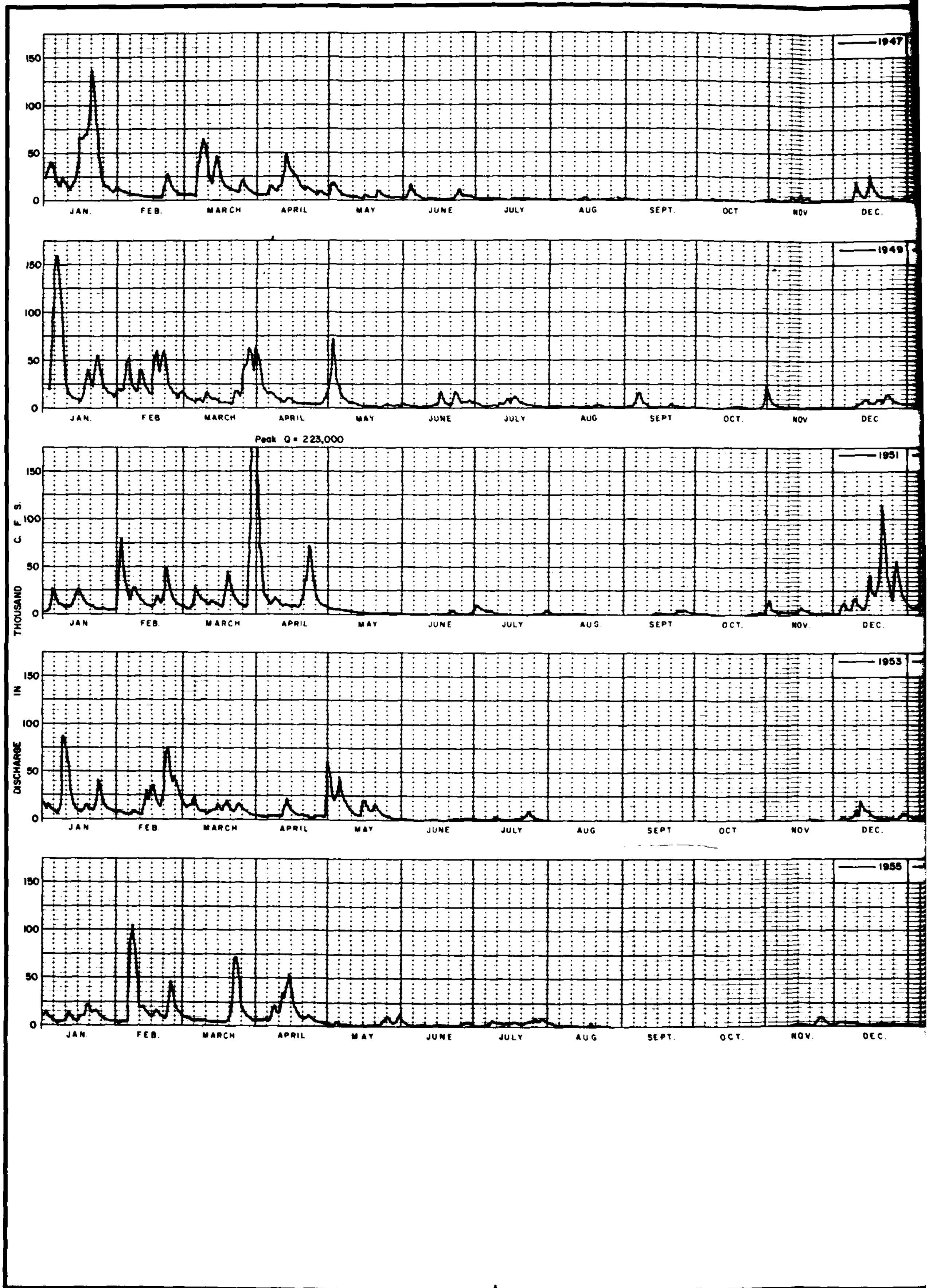
1 2

APPENDIX A, CHART I-3



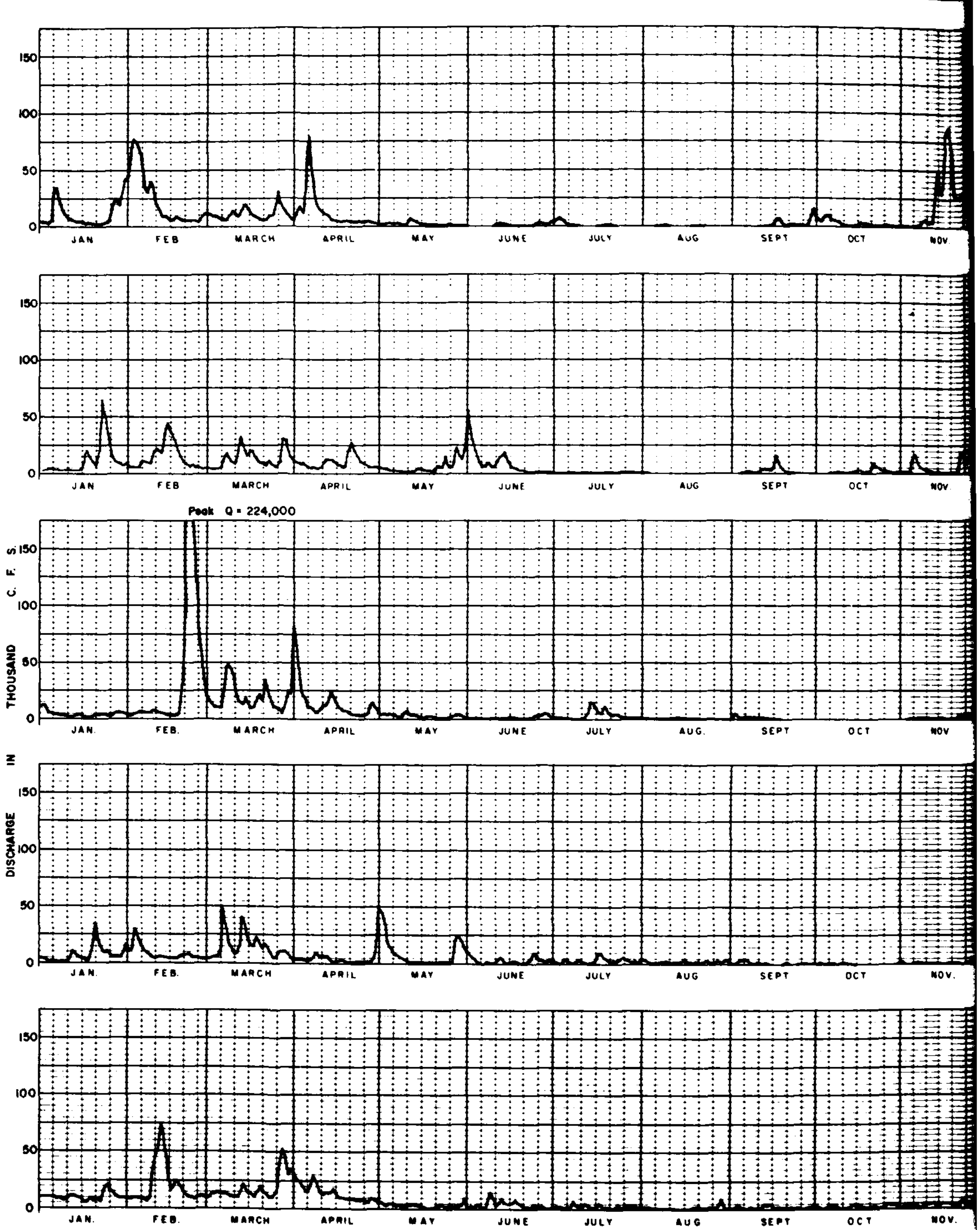
1947
1949
Peak Q = 223,000
1951
1953
1955
THOUSAND C.F.S.
DISCHARGE IN
150
100
50
0
JAN.
FEB.
MARCH
APRIL
MAY
JUNE
JULY
AUG
SEPT.
OCT
NOV
DEC.

U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA

BLACK WARRIOR - TOMBIGBEE RIVERS, ALABAMA

DISCHARGE HYDROGRAPHS
BLACK WARRIOR RIVER
AT NORTHPORT, AL.

1 2

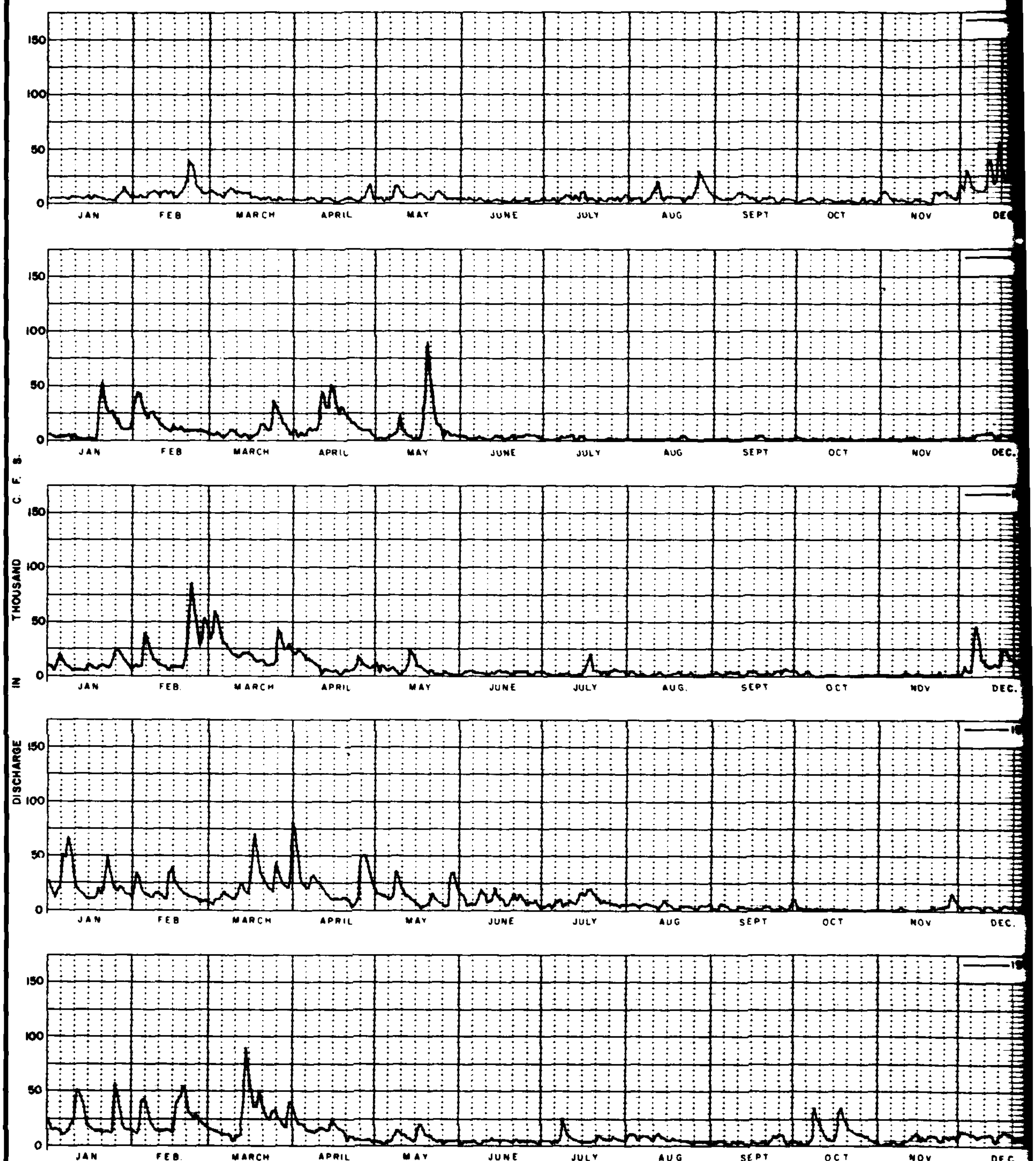

DISCHARGE IN THOUSAND C. F. S.
Peak Q = 224,000
0
50
100
150
JAN
FEB
MARCH
APRIL
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV

U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA

BLACK WARRIOR - TOMBIGBEE RIVERS, ALABAMA

DISCHARGE HYDROGRAPHS
BLACK WARRIOR RIVER
AT NORTHPORT, AL.

APPENDIX A, CHART I-5

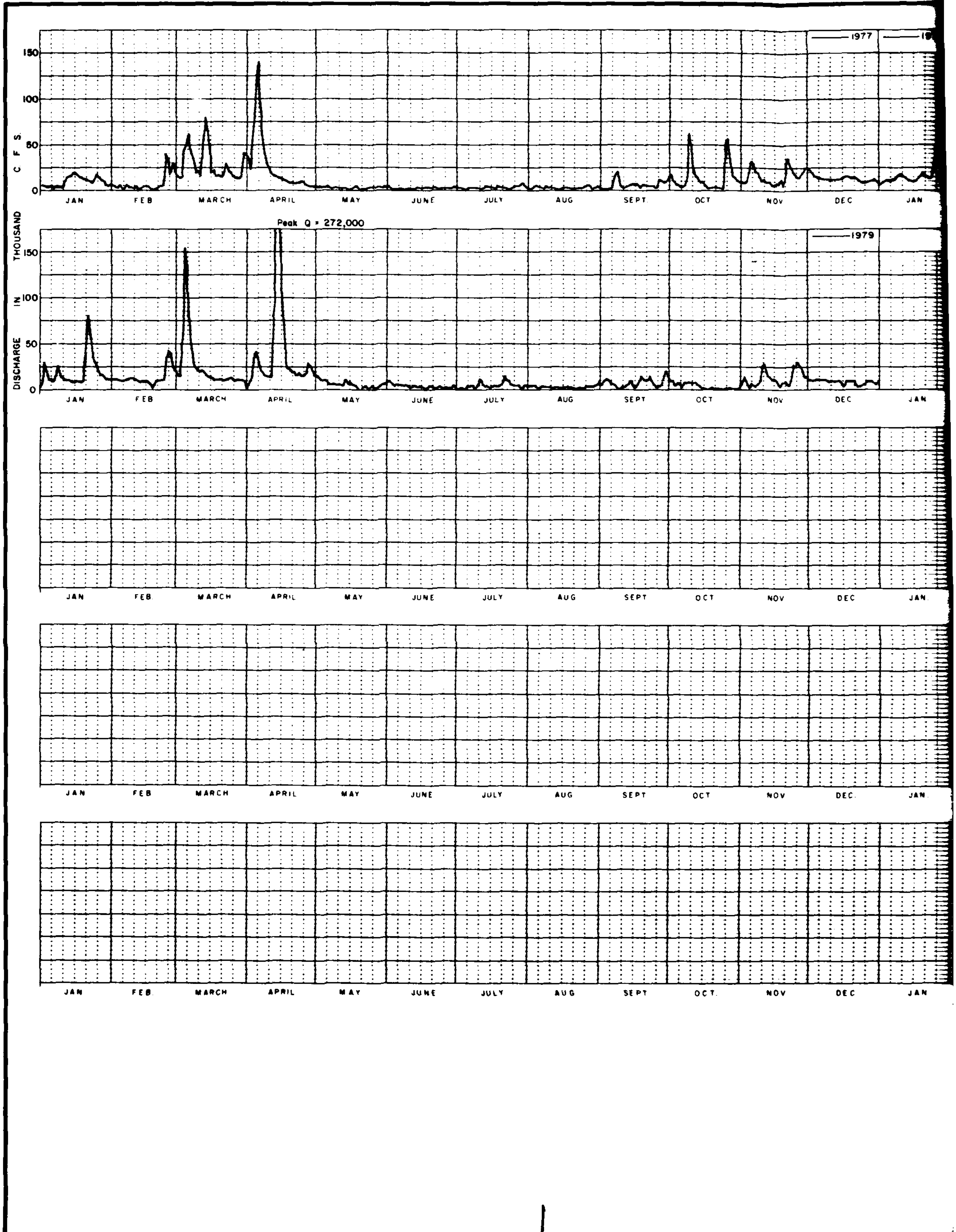

DISCHARGE IN THOUSAND C. F. S.
0
50
100
150
JAN
FEB
MARCH
APRIL
MAY
JUNE
JULY
AUG
SEPT
OCT
NOV
DEC.

U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA

BLACK WARRIOR - TOMBIGBEE RIVERS, ALABAMA

DISCHARGE HYDROGRAPHS
BLACK WARRIOR RIVER
AT NORTHPORT, AL.

APPENDIX A, CHART I-6

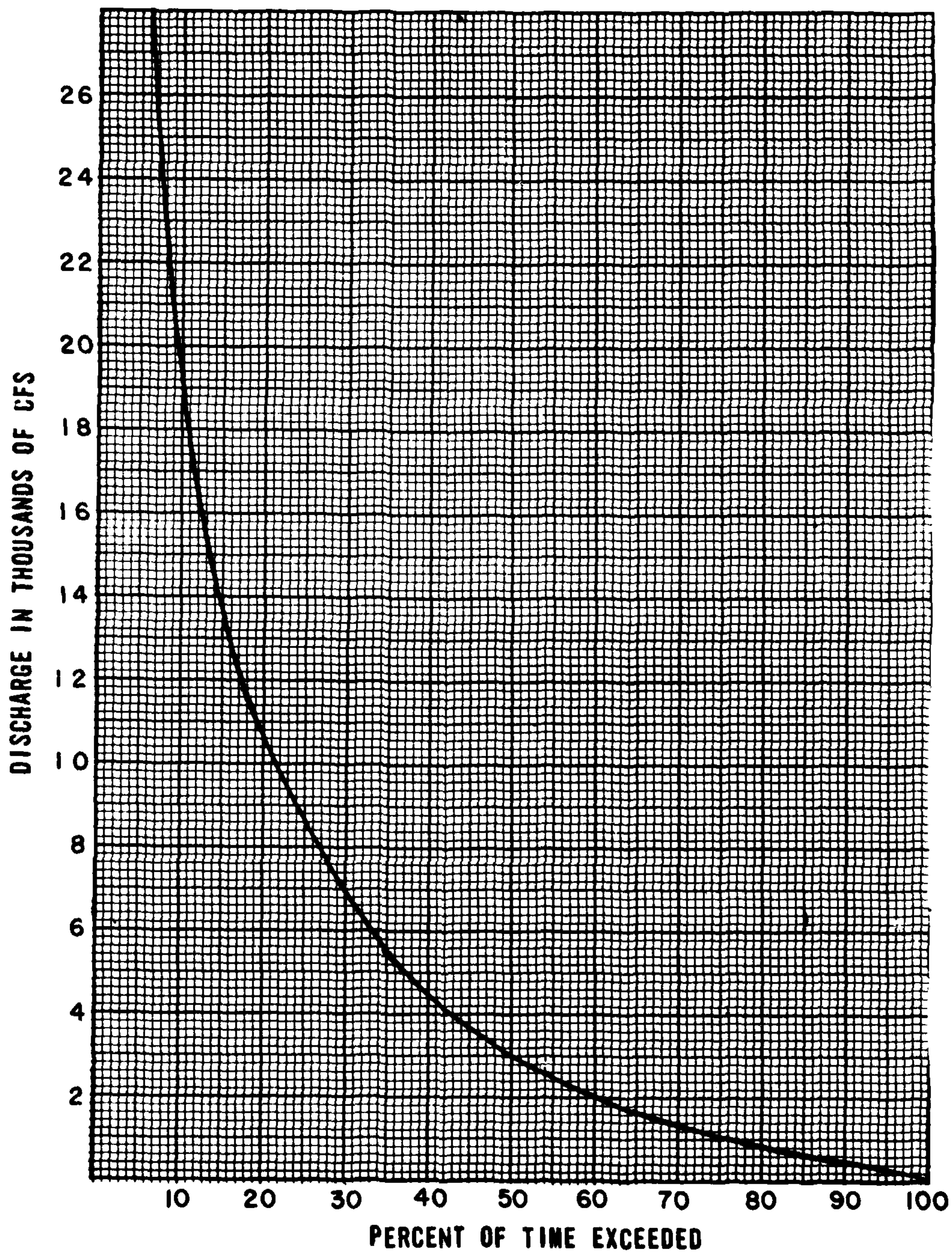

1977
19
150
100
50
0
JAN FEB MARCH APRIL MAY JUNE JULY AUG SEPT OCT NOV DEC JAN
Peak Q = 272,000
1979
DISCHARGE IN THOUSAND C F S
150
100
50
0
JAN FEB MARCH APRIL MAY JUNE JULY AUG SEPT OCT NOV DEC JAN
JAN FEB MARCH APRIL MAY JUNE JULY AUG SEPT OCT NOV DEC JAN
JAN FEB MARCH APRIL MAY JUNE JULY AUG SEPT OCT NOV DEC. JAN.
JAN FEB. MARCH APRIL MAY JUNE JULY AUG SEPT OCT. NOV DEC JAN

U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA

BLACK WARRIOR - TOMBIGBEE RIVERS, ALABAMA

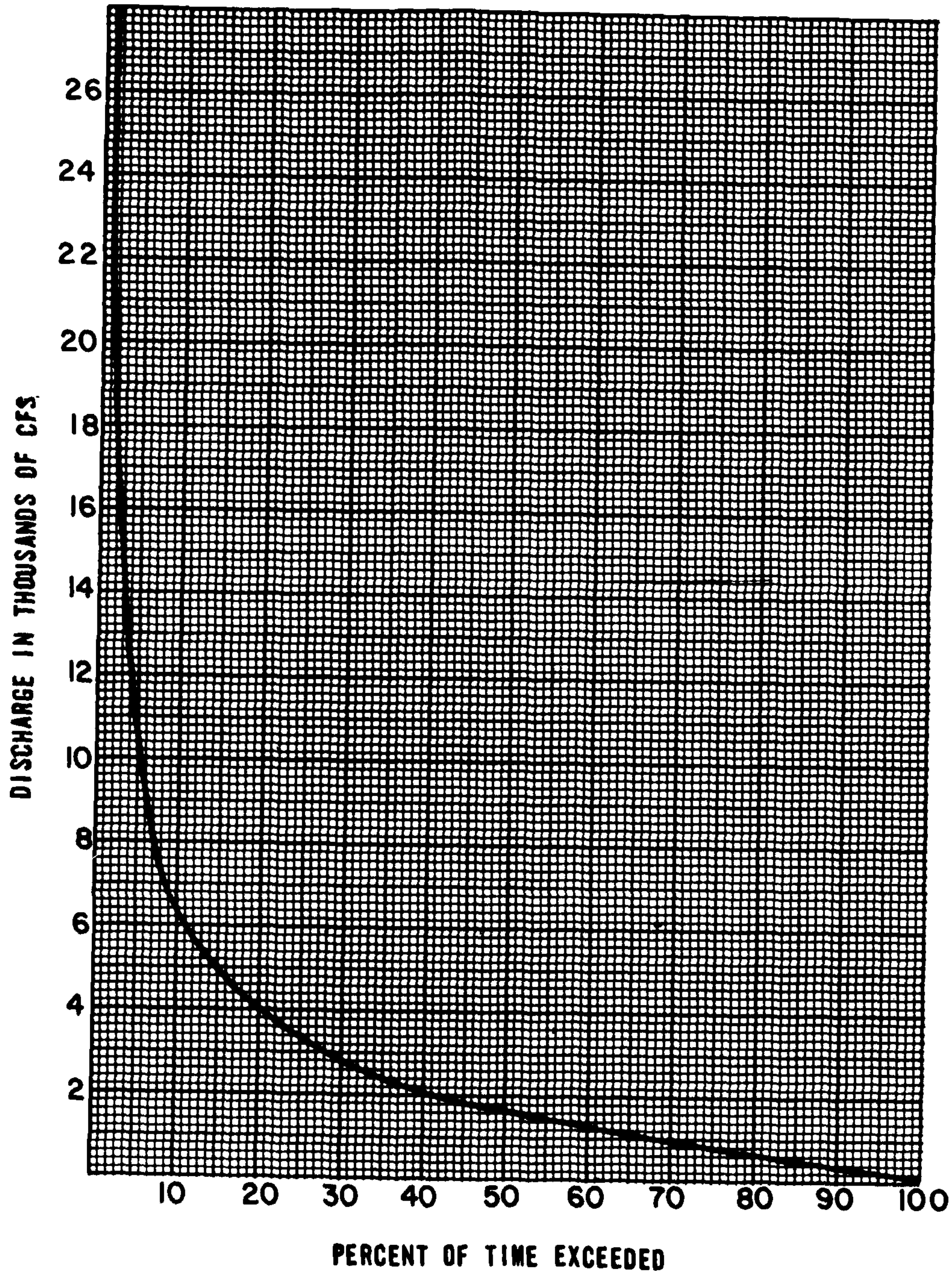
DISCHARGE HYDROGRAPHS
BLACK WARRIOR RIVER
AT NORTHPORT, AL

APPENDIX A, CHART I-7



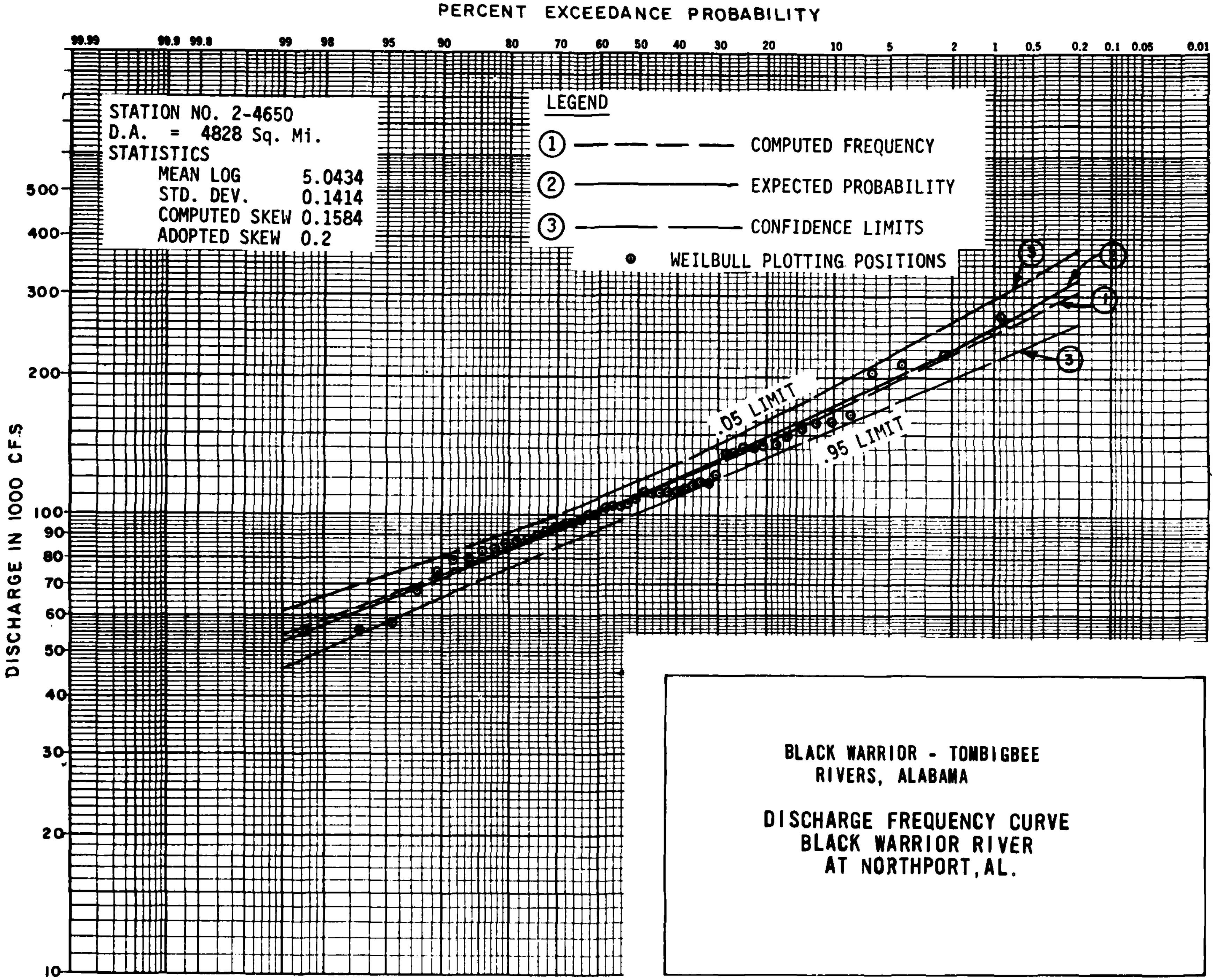
BLACK WARRIOR - TOMBIGBEE
RIVERS, ALABAMA

ANNUAL DISCHARGE - DURATION CURVE
BASED ON MEAN DAILY DISCHARGES
BLACK WARRIOR RIVER AT NORTHPORT, AL.
PERIOD OF RECORD 1898 - 1979



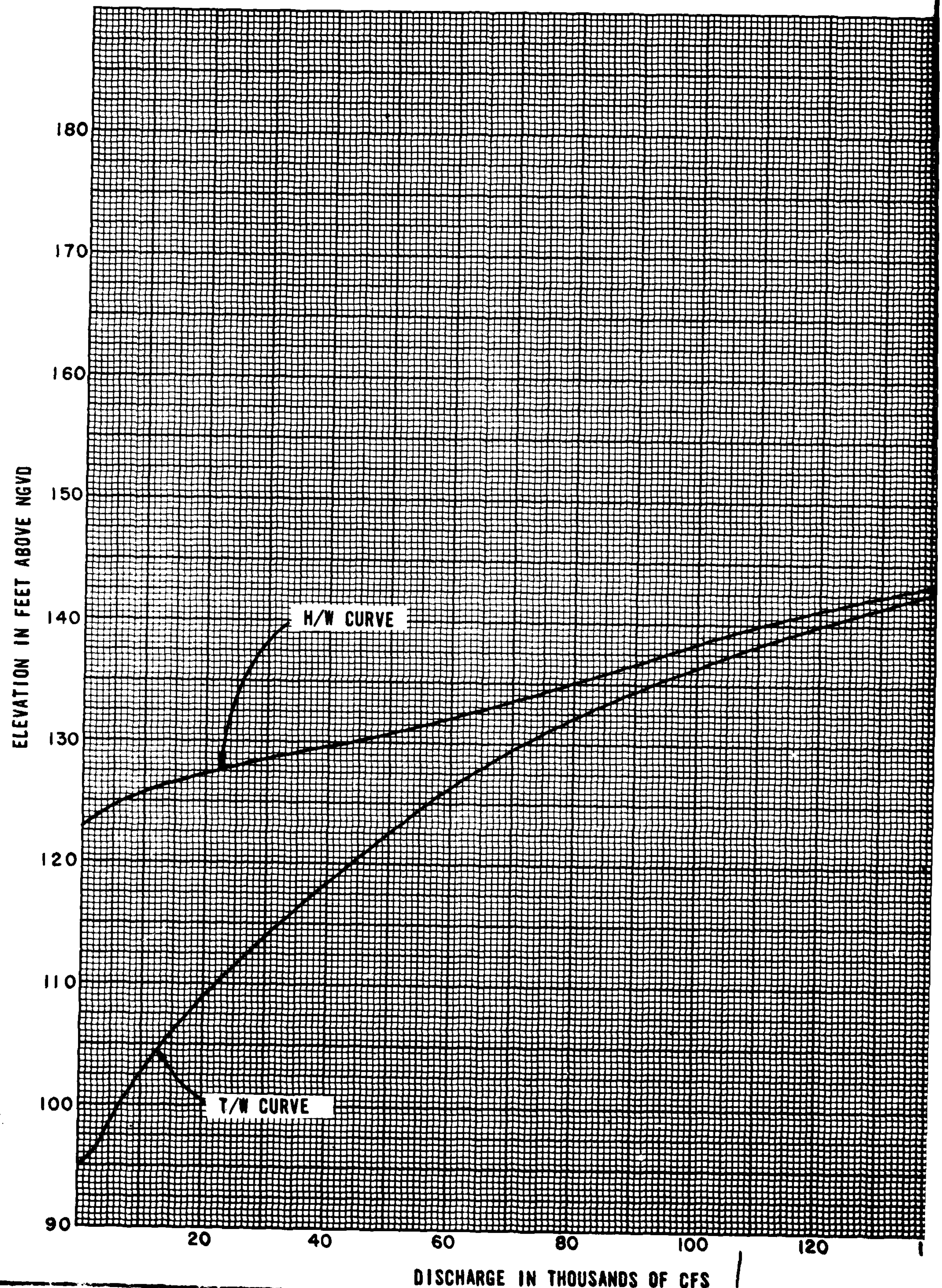
BLACK WARRIOR-TOMBIGBEE
RIVERS, ALABAMA

JULY DISCHARGE-DURATION CURVE
BASED ON MEAN DAILY DISCHARGES
BLACK WARRIOR RIVER AT NORTHPORT, AL.
PERIOD OF RECORD 1896 - 1979

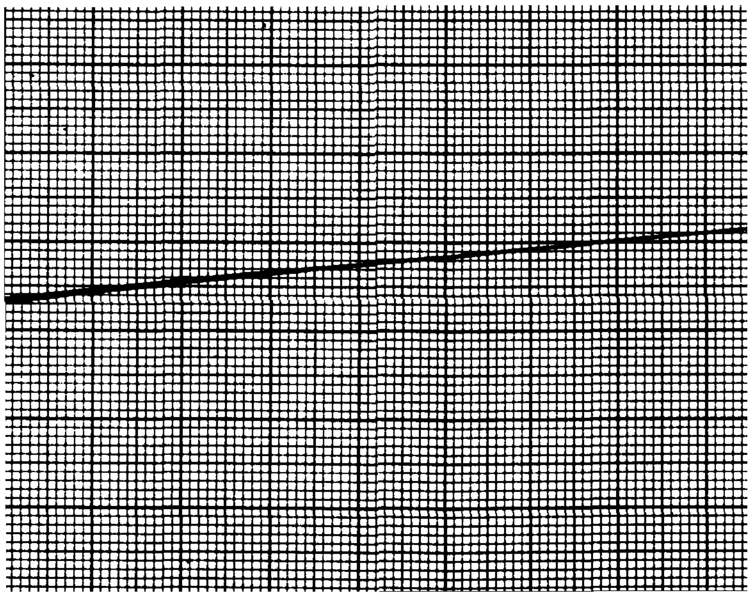


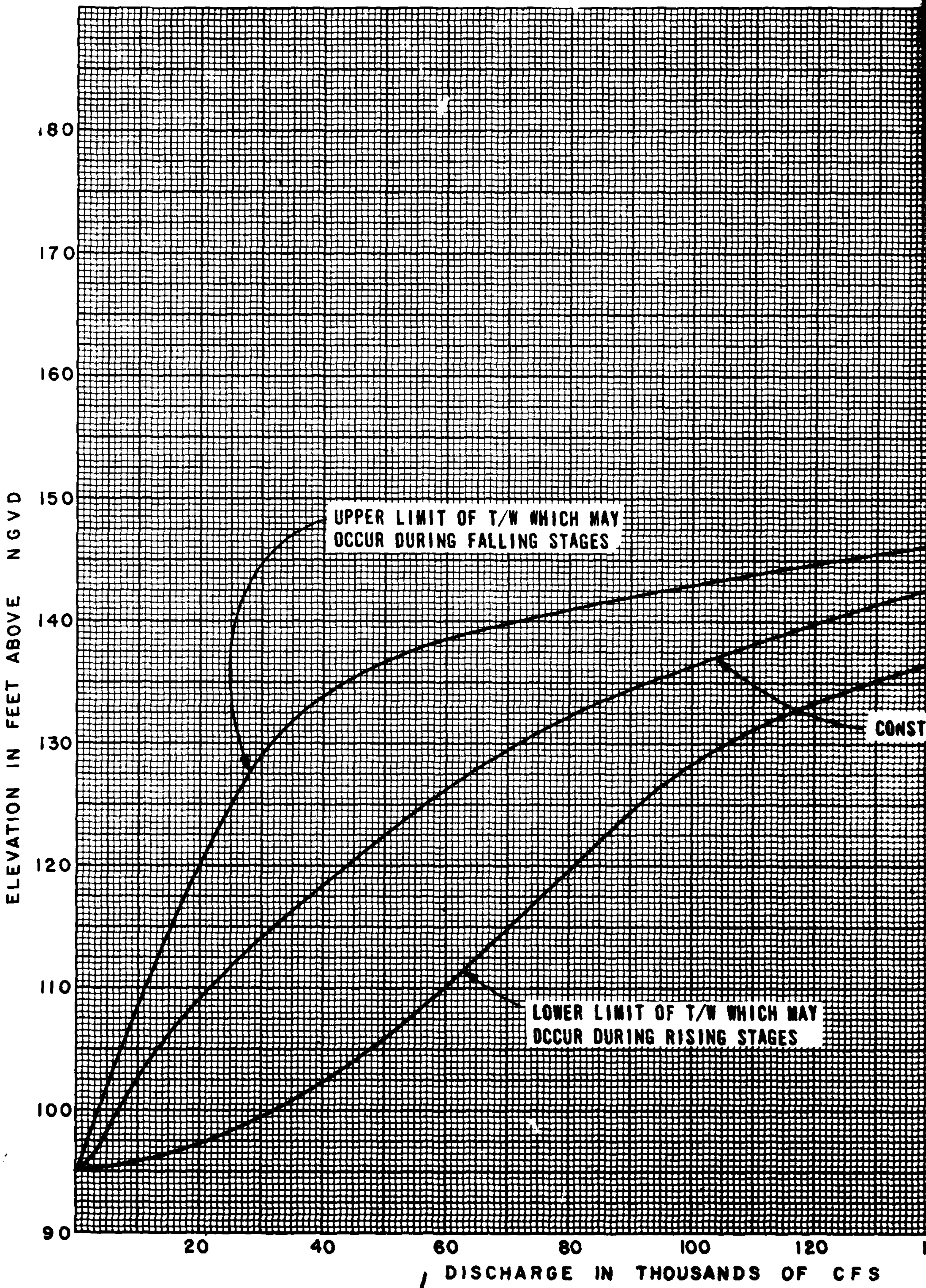
BLACK WARRIOR - TOMBIGBEE
RIVERS, ALABAMA

DISCHARGE FREQUENCY CURVE
BLACK WARRIOR RIVER
AT NORTHPORT, AL.

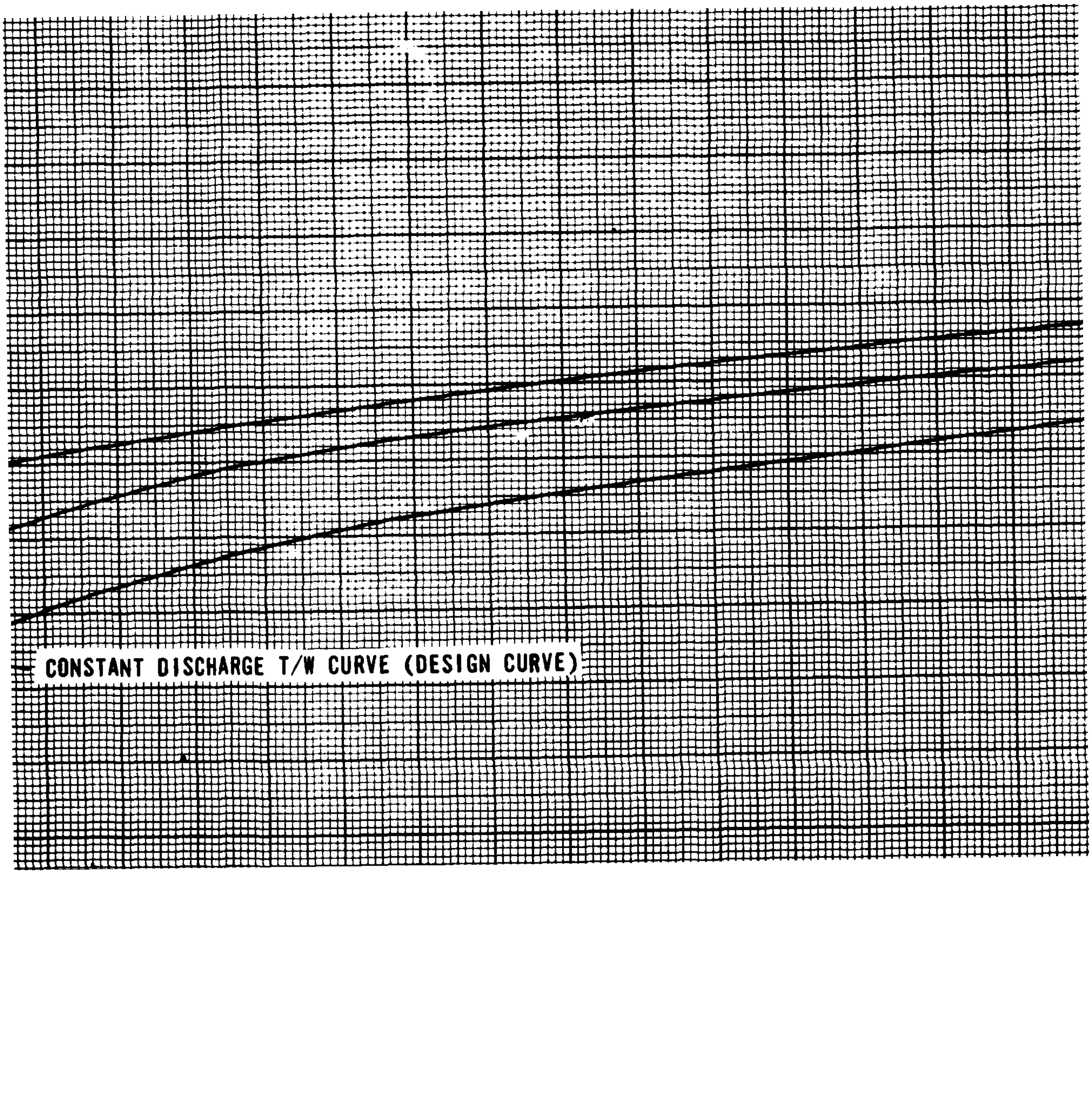


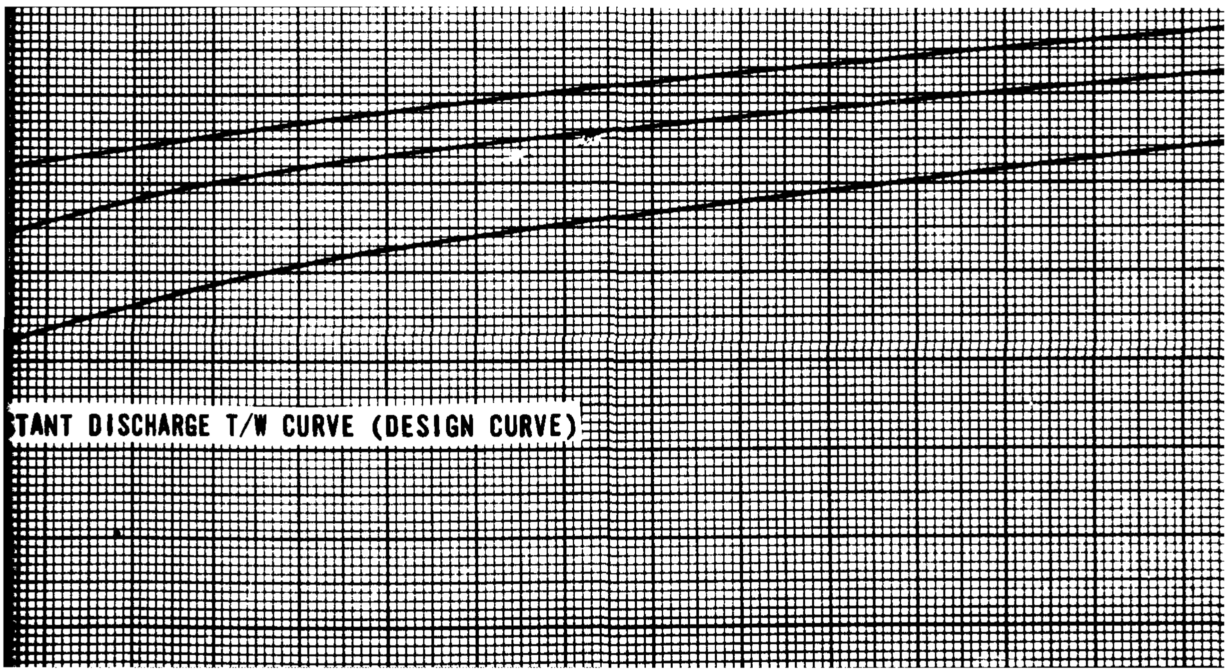
ELEVATION IN FEET ABOVE NGVD
180
170
160
150
140
130
120
110
100
90
H/W CURVE
T/W CURVE
20
40
60
80
100
120
DISCHARGE IN THOUSANDS OF CFS





ELEVATION IN FEET ABOVE NGVD
DISCHARGE IN THOUSANDS OF CFS
UPPER LIMIT OF T/W WHICH MAY OCCUR DURING FALLING STAGES
LOWER LIMIT OF T/W WHICH MAY OCCUR DURING RISING STAGES
90
100
110
120
130
140
150
160
170
180
20
40
60
80
100
120


CONSTANT DISCHARGE T/W CURVE (DESIGN CURVE)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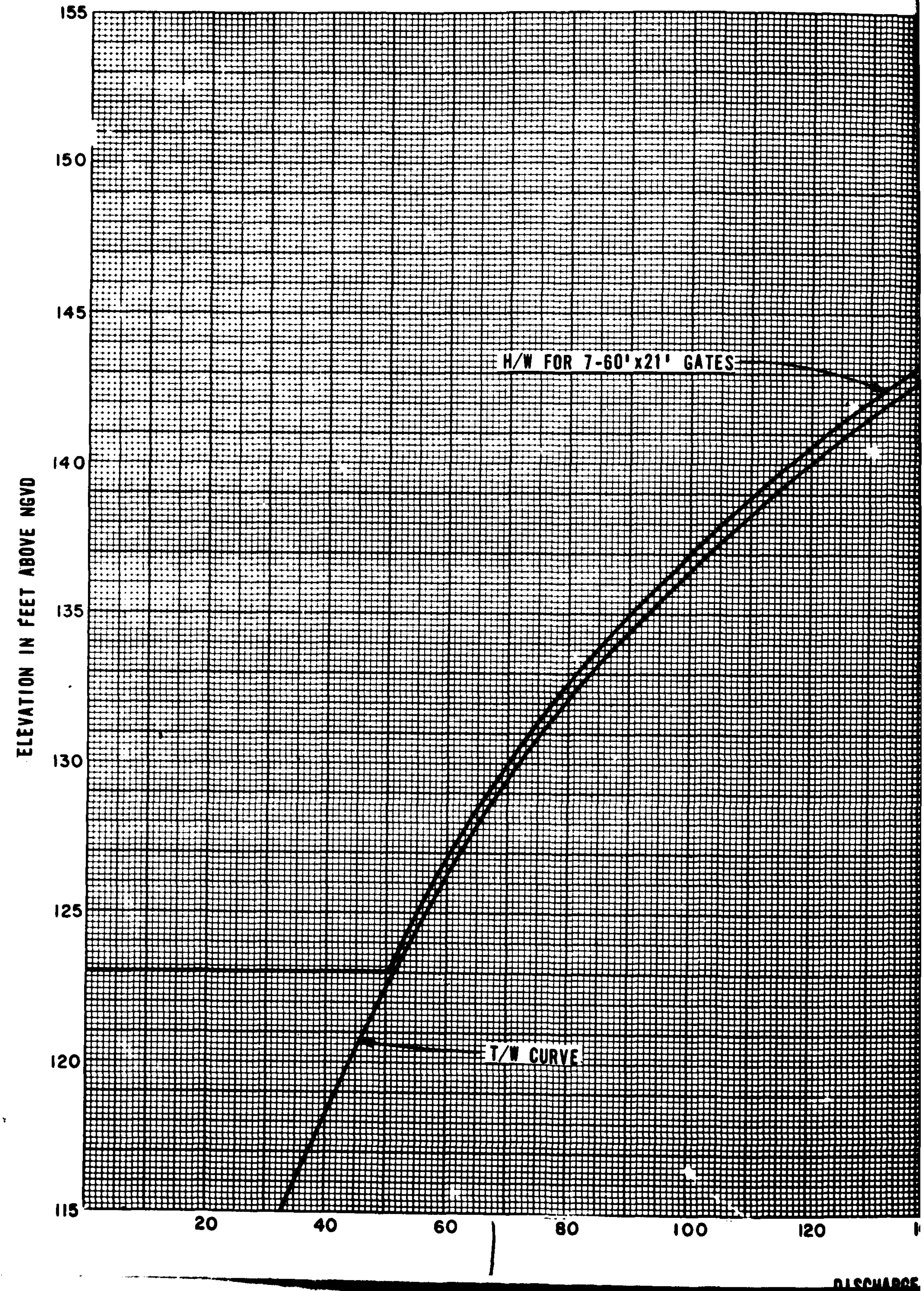
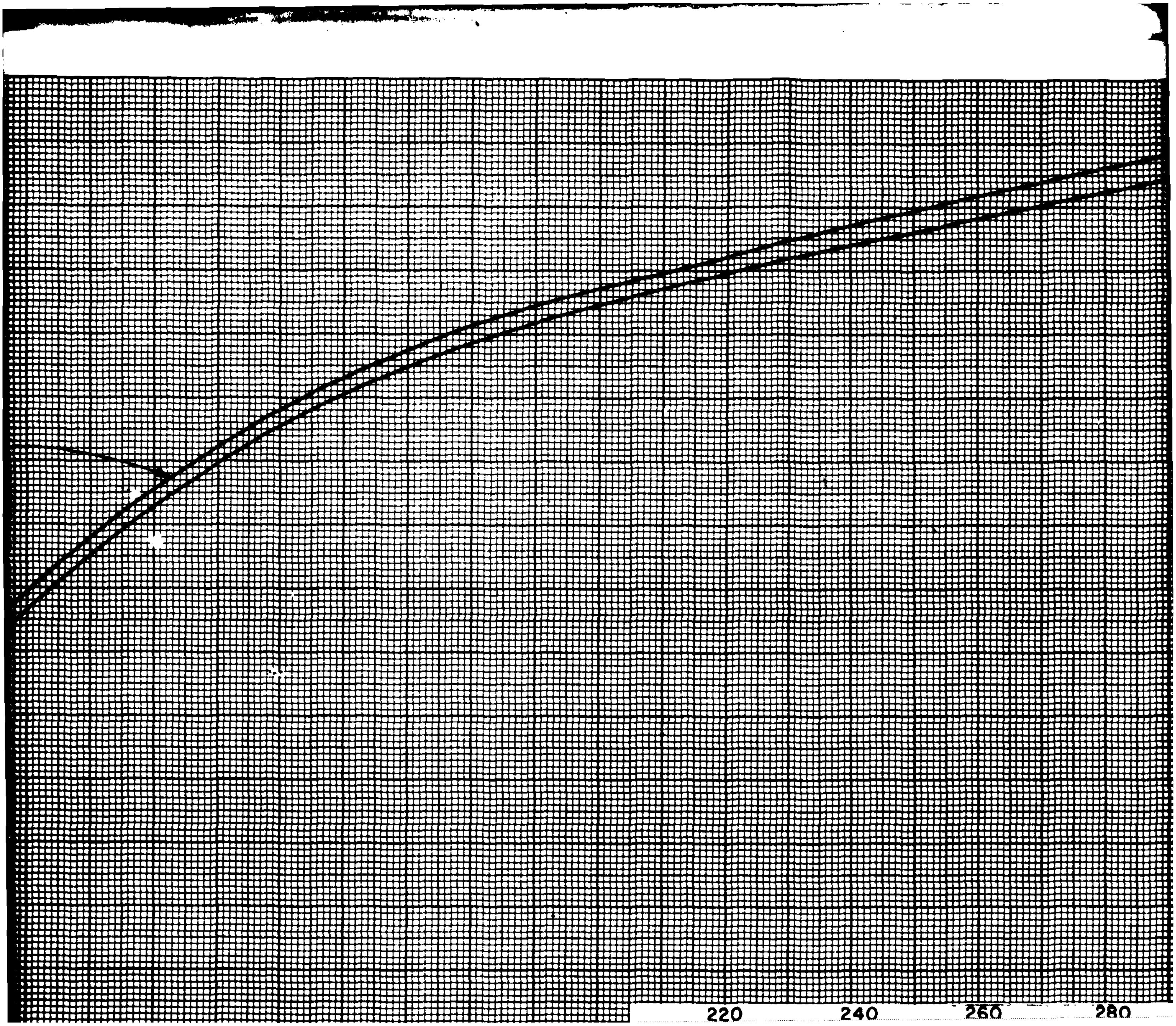
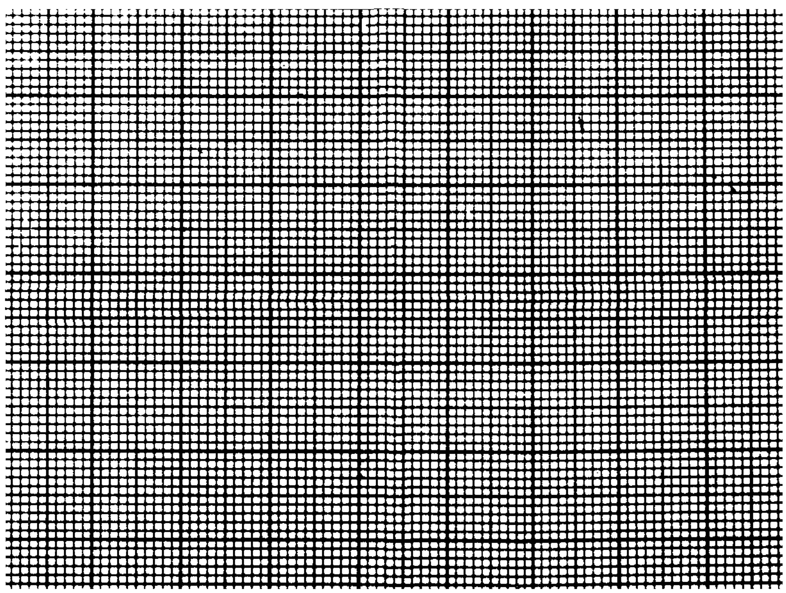
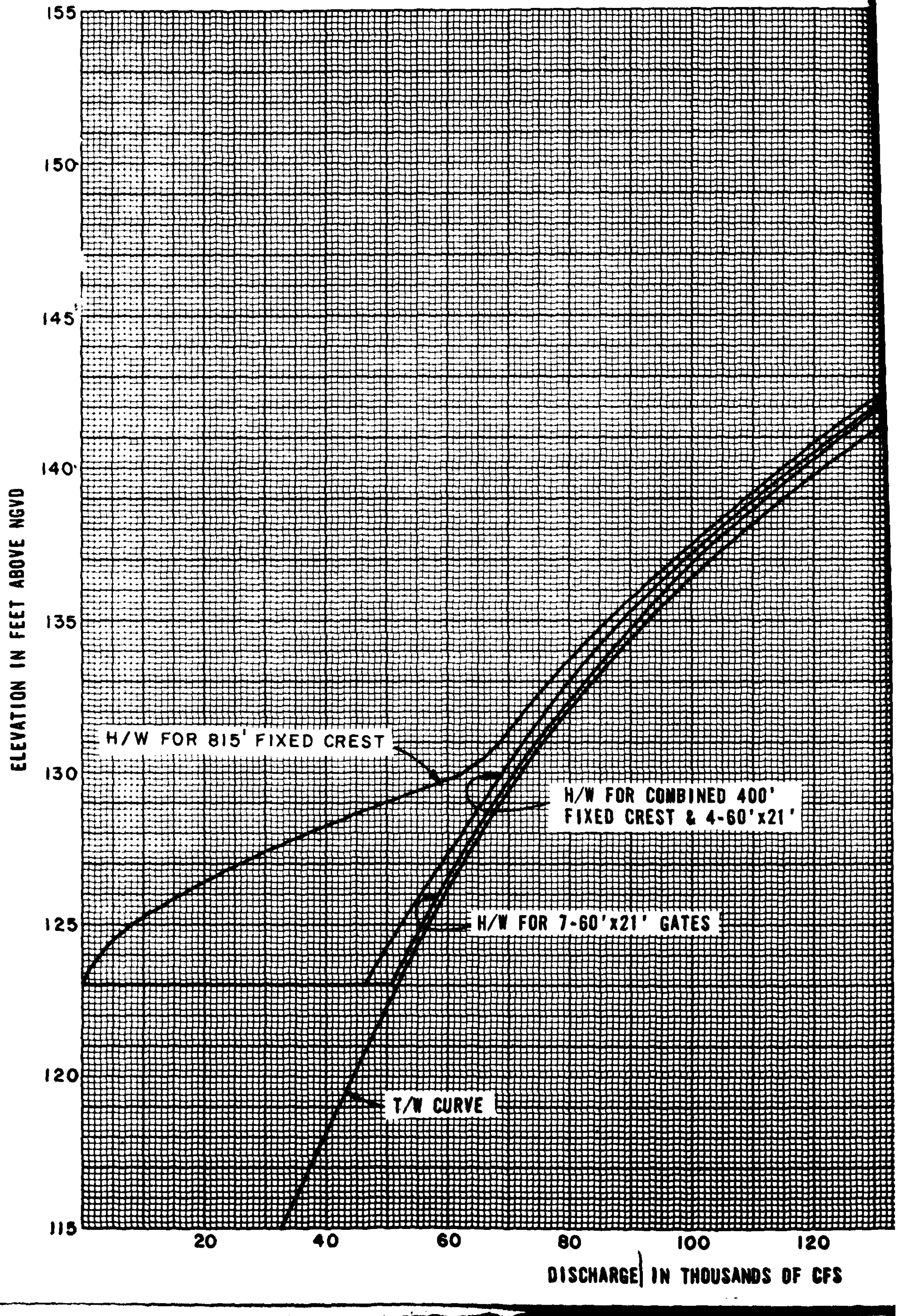


ELEVATION IN FEET ABOVE NGVD
155
150
145
140
135
130
125
120
115
20
40
60
80
100
120
H/W FOR 7-60'x21' GATES
T/W CURVE

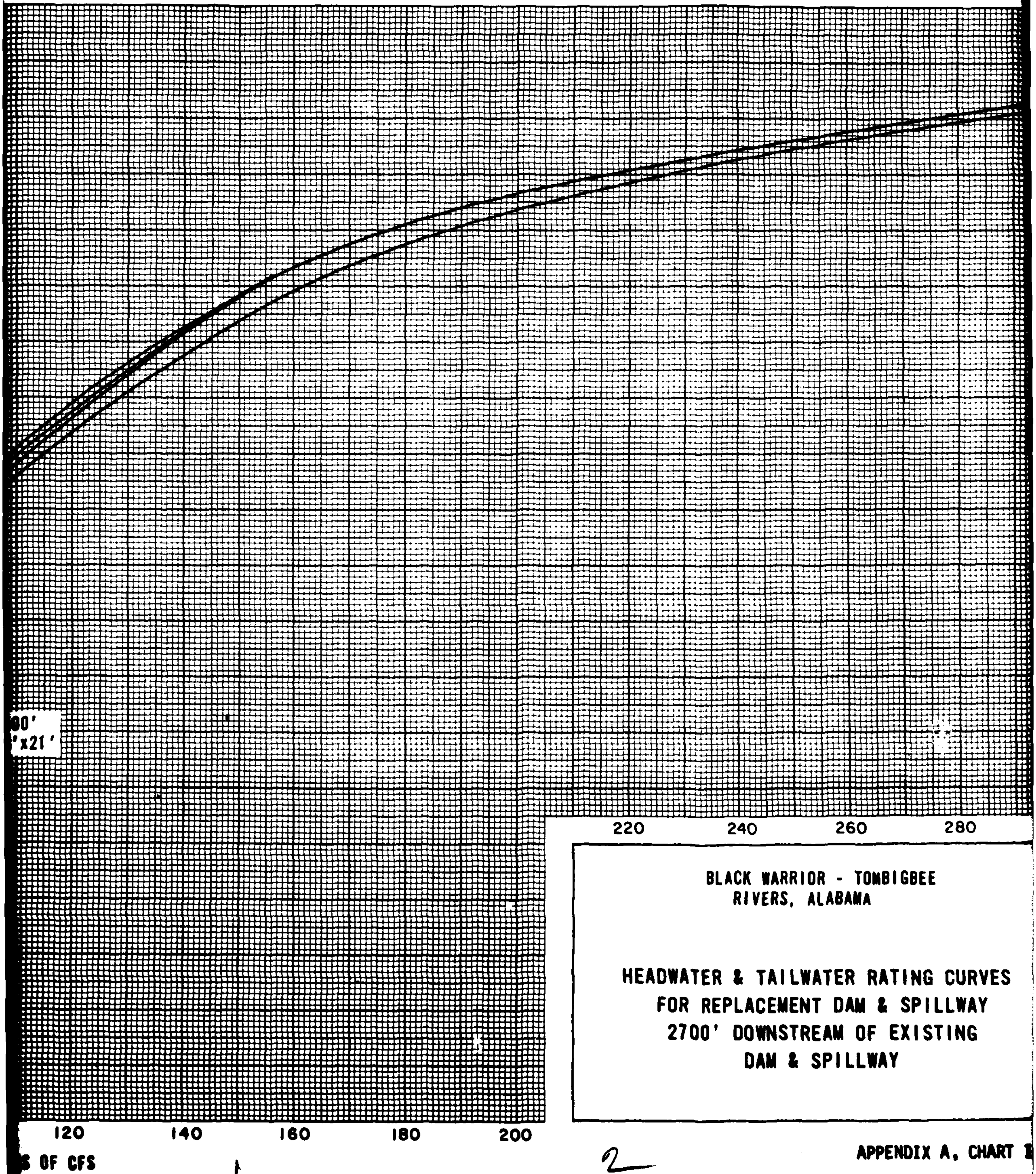


220
240
260
280





ELEVATION IN FEET ABOVE NGVD
155
150
145
140
135
130
125
120
115
20
40
60
80
100
120
DISCHARGE IN THOUSANDS OF CFS
H/W FOR 815' FIXED CREST
H/W FOR COMBINED 400' FIXED CREST & 4-60'x21'
H/W FOR 7-60'x21' GATES
T/W CURVE

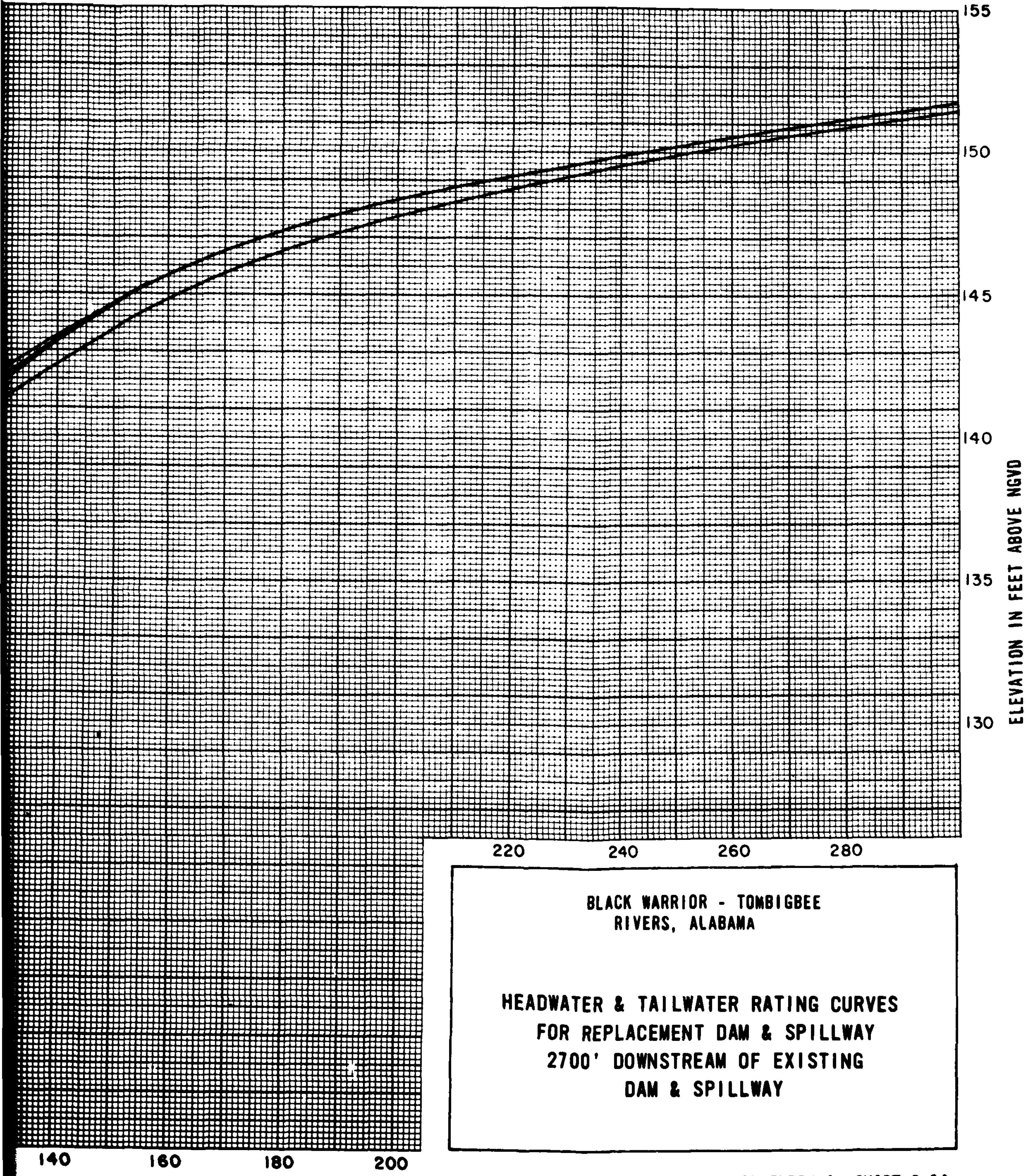


BLACK WARRIOR - TOMBIGBEE
RIVERS, ALABAMA

HEADWATER & TAILWATER RATING CURVES
FOR REPLACEMENT DAM & SPILLWAY
2700' DOWNSTREAM OF EXISTING
DAM & SPILLWAY

APPENDIX A, CHART I

2

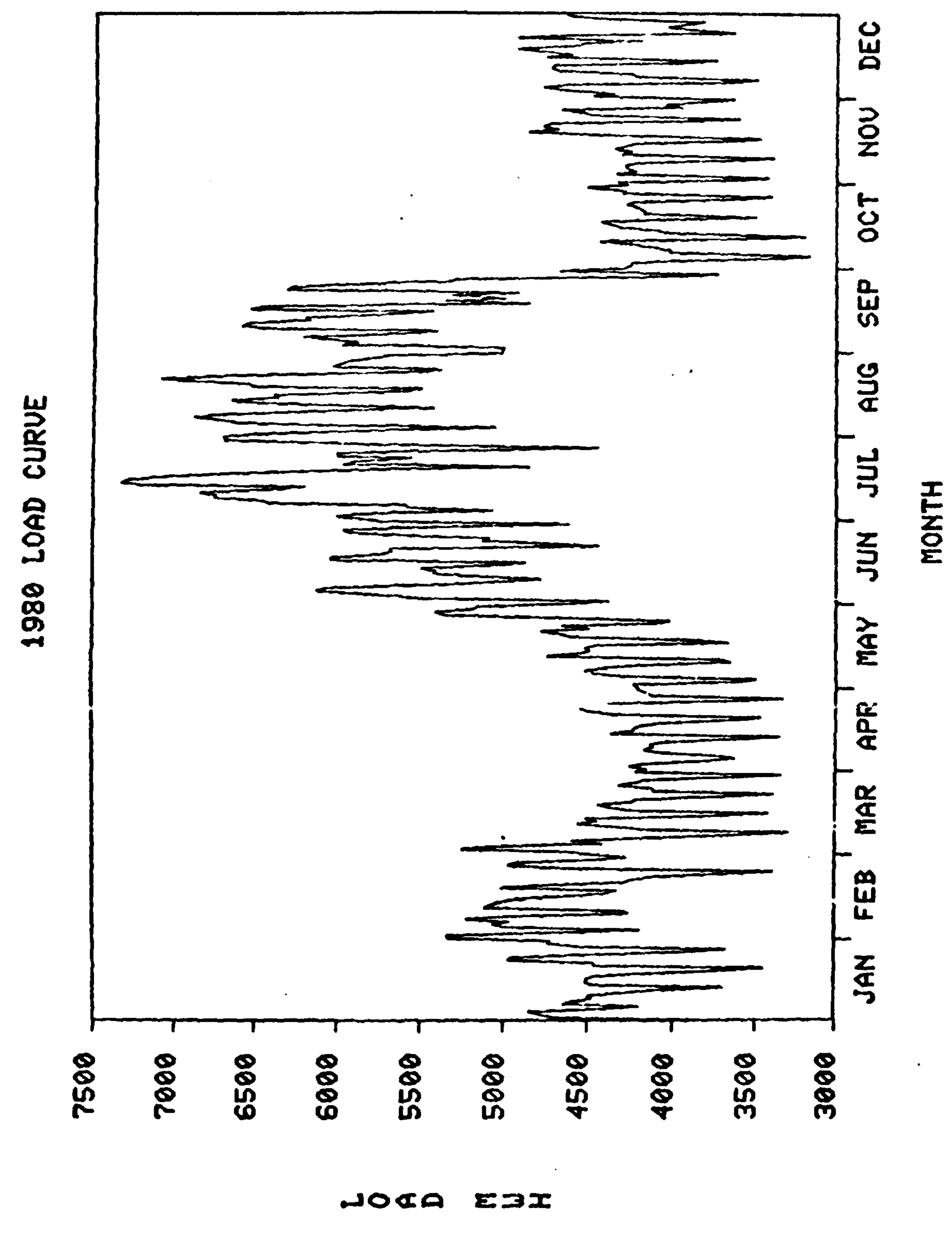


BLACK WARRIOR - TOMBIGBEE
RIVERS, ALABAMA

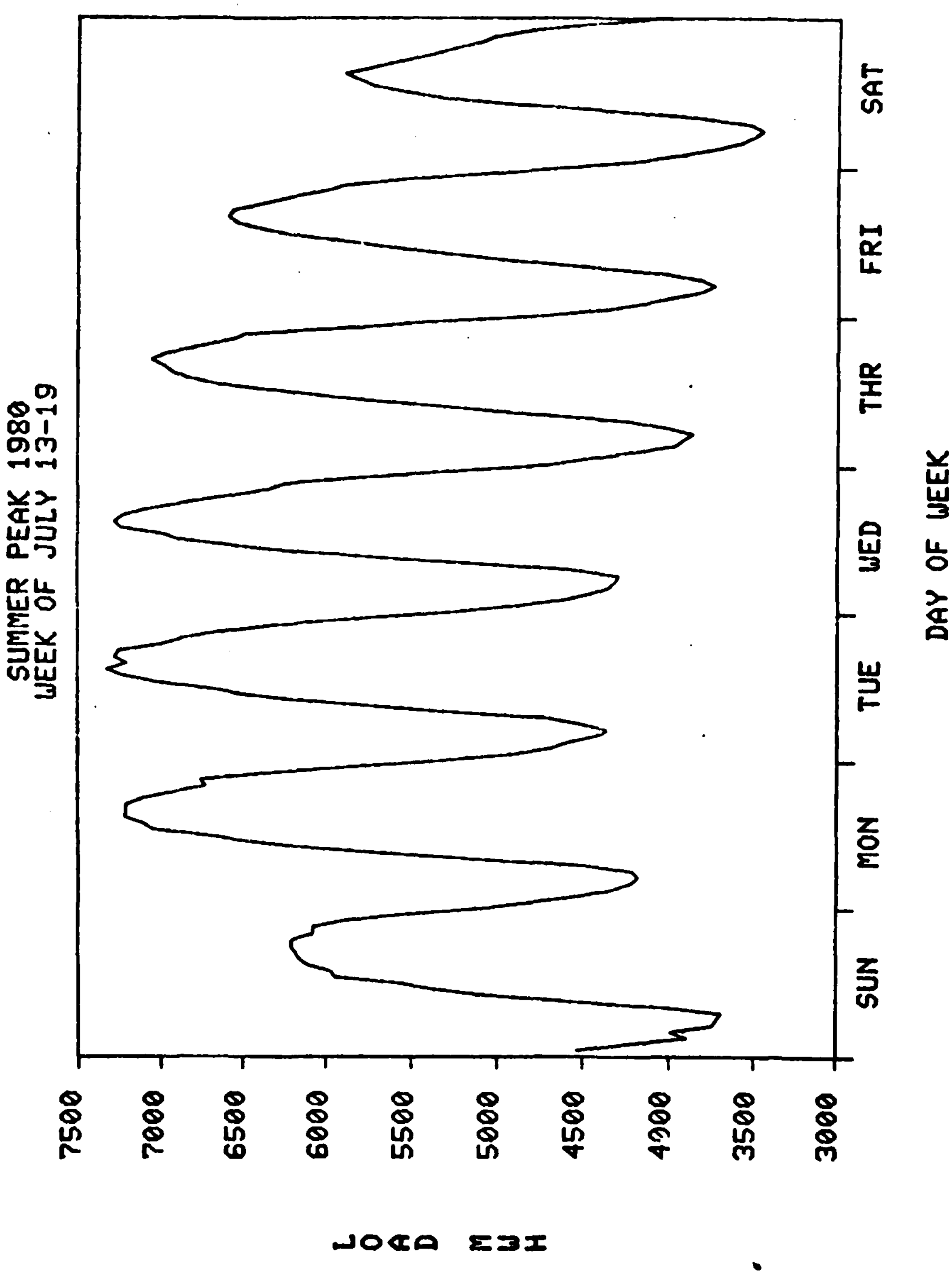
HEADWATER & TAILWATER RATING CURVES
FOR REPLACEMENT DAM & SPILLWAY
2700' DOWNSTREAM OF EXISTING
DAM & SPILLWAY

APPENDIX A, CHART I-14

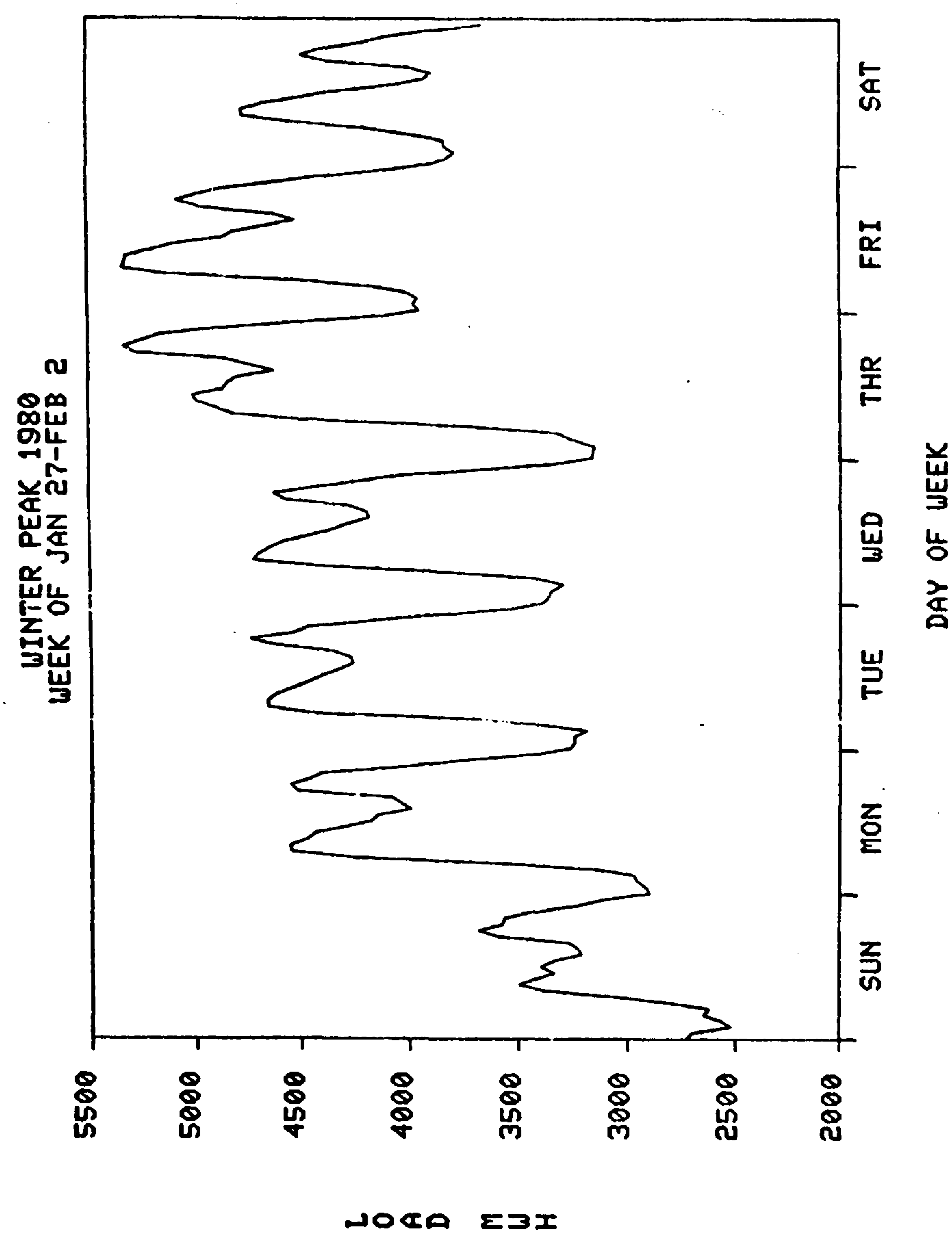
1 2 3



APPENDIX A, CHART I-15

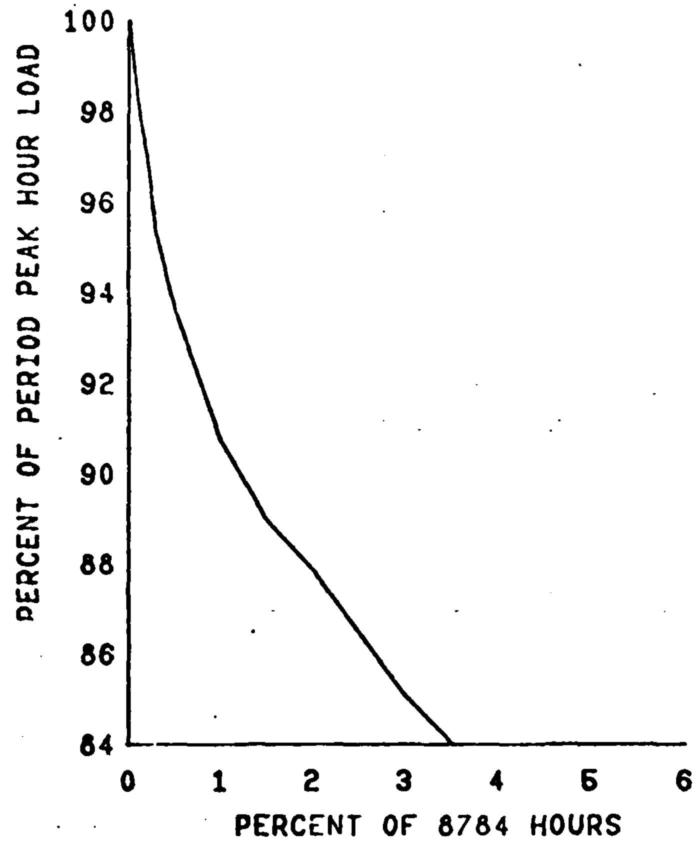


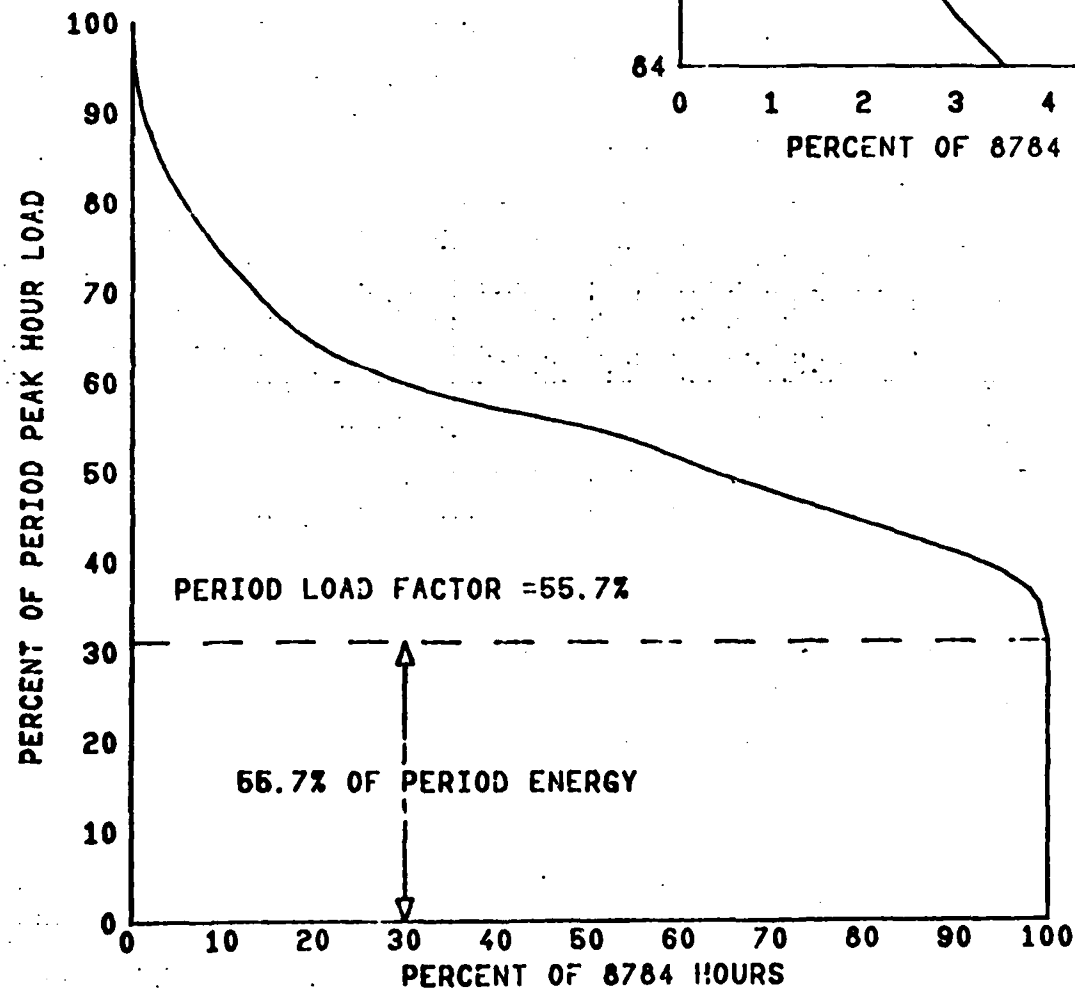
APPENDIX A, CHART I-16



APPENDIX A, CHART I-17

PEAK =7220 MW
ENERGY =35337 X 10^3 MWH
PERIOD =1/1/80 TO 12/31/80

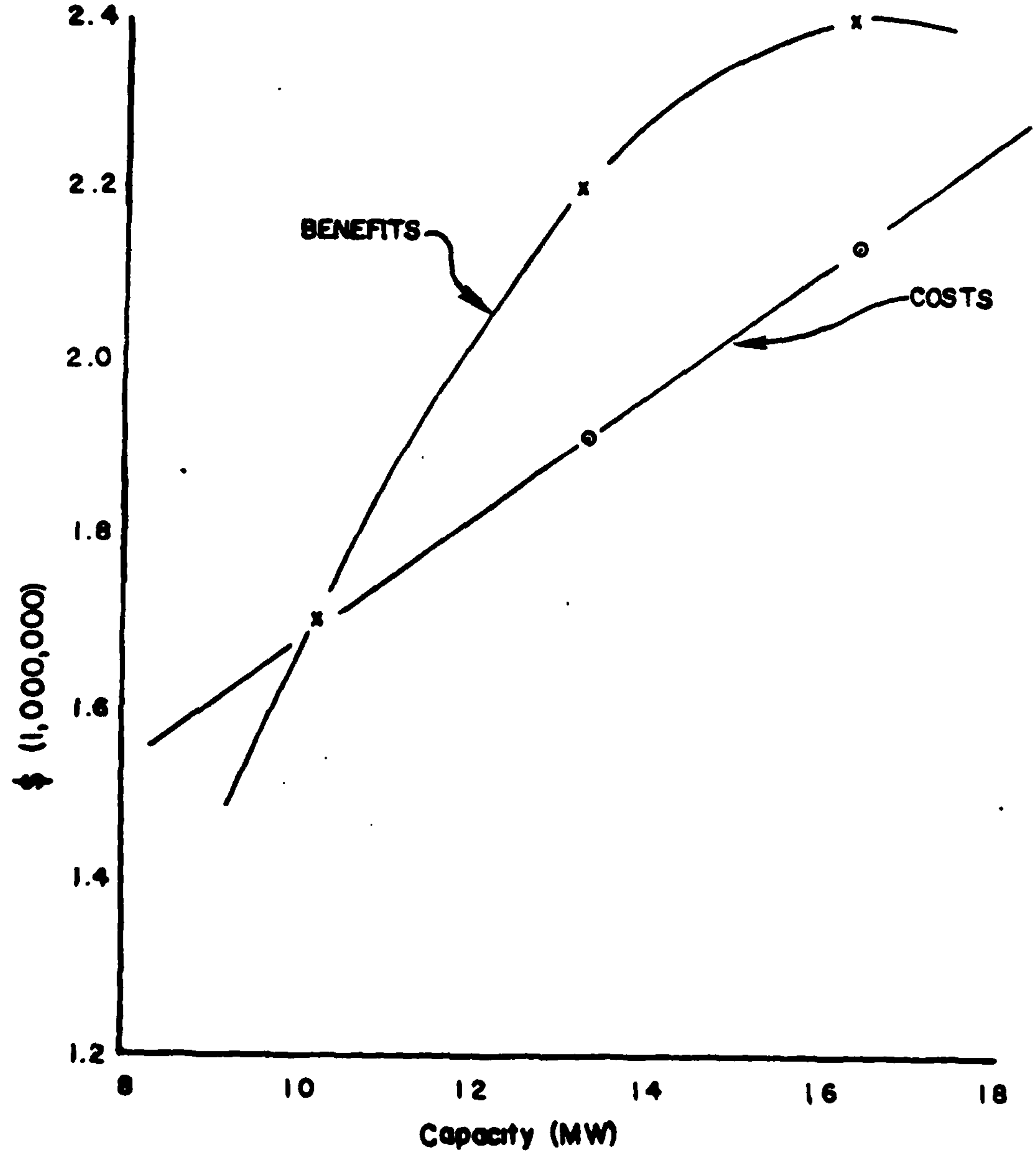




ALABAMA POWER COMPANY
LOAD DURATION
1 /1 /80 TO 12/31/80

APPENDIX A, CHART I-18

06/20/81



HYDROPOWER ANALYSIS

APPENDIX A, CHART I-19
r/12/83

APPENDIX A

SECTION II

GEOLOGY
MODERNIZATION OF OLIVER LOCK AND DAM

The modernization scheme for Oliver Lock and Dam includes three possible structure sites; a mid-river location near the existing lock, another location landward of the existing lock, and a location approximately 2,700 feet downstream of the present structures.

All of the sites considered are located within the Coastal Plains physiographic province near its northern boundary which closely approximates the line of contact between the older Pottsville formation and the younger Coker formation. The Coastal Plain province is characterized here by irregular and flat-topped hills and ridges.

The Pottsville formation consists of interbedded sandstone, shale, and coal. These are relatively hard rocks that have a low dip of about 175 feet per mile to the southwest. Beginning with Oliver Lock and Dam, all of the dams upstream on the Warrior River are founded on the Pottsville formation. Coal is commercially mined from the Pottsville at many places in Tuscaloosa County and thin seams and/or lamina occur in the subsurface in this area. However, at the sites being considered, coals are too thin and discontinuous to be mined and their commercial value will have no affect on the site selection. In the "Mineral Resources of Tuscaloosa County, Alabama," published in 1978 by the Geological Survey of Alabama, no economic mineral resources are described as being present in the immediate area.

The Coker formation of the Tuscaloosa Group unconformably overlies the Pottsville formation and dips 30 to 40 feet per mile to the southwest. The Coker formation is unconsolidated sand and gravel and includes marine carbonaceous clay and lenticular, varicolored clay. These are relatively

soft materials and less desirable as a foundation than the Pottsville formation. The Coker has been removed by erosion in the vicinity of Oliver Lock and Dam but a 12- to 14-foot thick section is present on the right side of the river at the downstream site. The Coker is probably present also on the left bank of the downstream site but there are no borings to verify this.

Structures at either alternative site would be founded on the Pottsville formation. A study was made of the logs of borings that were prepared between 1932 and 1938 for the foundation design studies of the existing structures. The qualitative terms used at that time cannot be correlated with the terms used today and the rock cores are no longer available for inspection. For those reasons, a minimum value is placed on the old logs and they are considered useful only as a guideline. Those logs show a sequence of interbedded sandstone, shale, and coal that is typical of the Pottsville formation. Though no faults were logged, abrupt changes in lithology indicate that some faults are present. En echelon normal faults, striking northwest and dipping southeast, are common in this area but they are inactive and do not normally pose a serious construction problem. This type of fault is present beneath the Holt and Bankhead projects and was treated with "dental" excavation and backfilling during construction. Coal seams were logged and will influence the selection of a foundation grade.

The lower foundation at the existing lock is elevation 69 and that same foundation elevation can probably be used for the alternative landward site. Top of rock at the landward site is approximately elevation 96 and the overburden is estimated to be 45 - 50 feet thick. At the mid-river location, top of rock is about elevation 73 and suitable foundation grade is generally estimated at elevation 60. Between two and four feet of sand and gravel overlies top of rock within the river section. At the site 2,700 feet downstream from Oliver Lock and Dam, the structures can be founded on a sandstone unit of the Pottsville formation. Based on four borings made in 1971, the average top of rock is at elevation 70 and the

average top of sound rock is elevation 60. These same borings show that alluvial silt, clay, and sand is 50 feet thick on the flood plain (Chart II-1).

For excavation slopes in overburden and in the Coker formation where it is present, use three horizontal and one vertical. At the top of the Pottsville formation, place a 20 feet wide berm. Use slopes of one horizontal and one vertical in weathered rock with a 20 feet wide berm at the top of sound rock. Cuts in sound rock can be presplit to a slope of one horizontal and four vertical.

The flood plain along this part of the Warrior River is underlain by alluvial sediments which include some coarse grained materials. Deep excavations on the flood plain will require a dewatering system due to a high water table.

Because of the proximity of two of the sites to the existing lock, special attention will be given to excavation slopes and blasting. For those two sites, stability of the existing lock will be an important factor to consider and "tie-down" of the lock with post-tensioned anchors will probably be required.

For preliminary design purposes, the foundation design values used for the Holt and Bankhead projects can be used for the three sites being considered. An extensive geotechnical study of the selected site will be required in order to determine foundation grades and design values, excavation quantities, dewatering method, blasting criteria, excavation slopes, cost estimates, sources of construction materials, etc.

Pertinent geologic conditions relative to siting a new lock and dam downstream from Oliver Lock and Dam are outlined in a 1970 Trip Report (see Page A-II-4).

1. **SUBJECT:** Trip Report

2. **LOCATION AND DATE:** William Bacon Oliver Lock and Dam, Tuscaloosa, Alabama, Nov. 30 and Dec. 1, 1970

3. **ATTENDEES:** Mr. A. F. Baer
Mr. A. W. Kerr
Mr. J. B. Hildreth
Mr. J. H. Bryan

4. **PURPOSE:** To determine feasibility of constructing a new lock and dam downstream from William Bacon Oliver Lock and Dam

5. **NARRATIVE:** The attendees arrived at W. B. Oliver Lock and Dam about 1:00 PM, November 30. There we boarded a boat piliated by Operations Division personnel and proceeded about 10 miles downstream to "twelvemile rock", and then returned to the lock about 4:30 PM. Along the way we stopped several times to observe land use or outcrops along the river banks. The next morning I visited the Alabama Geological Survey to compile available geologic data within the study area. The other attendees examined industrial development along the flood plain downstream of W. B. Oliver Lock and Dam. We returned to Mobile Tuesday afternoon.

The enclosed sketch summarizes the geologic conditions pertinent to siting of a new lock and dam. William Bacon Oliver Lock and Dam is located along the contact of the Gulf Coastal Plain and the Cumberland Plateau physiographic province and is founded on hard rock in the uppermost part of the Pottsville formation. Southwestward (downstream) from Oliver L&D the Pottsville formation dips underneath the coastal plain sediments and becomes progressively deeper, with a corresponding increase in thickness of the Coker formation as indicated on the geologic profile. The Coker formation consists of sand and gravel with some fairly hard clay layers. So called "twelvemile rock" is part of the Coker Formation which is simply compact sand with some clay layers that is standing on a near vertical slope. This formation would be an extremely poor foundation for a lock and dam. The bearing capacity would be low; there would have to be a positive cut-off underneath the structures because of high underseepage potential; dewatering and hydrostatic relief during and after construction would be a major cost factor; and other unforseen problems could be anticipated.

It would be far better from a foundations and construction standpoint to found the structures on rock of the Pottsville formation. The top of the Pottsville formation was exposed to erosional forces for considerable geologic time and therefore can be expected to be very irregular and deeply

weathered for at least 10 feet deep, with open joints very likely extending 10 to 20 feet below the top of rock. There is a good probability of finding suitable foundation rock at an elevation high enough to economically construct on for 1½ to 2 miles downstream from W. B. Oliver L&D. This probability progressively decreases in a downstream direction, with Tater Hill Creek (indicated on the geologic profile) being the downstream limit of possible sites for a rock foundation.

1 incl
as stated

Jack H Bryan
JACK H. BRYAN
Geologist

Supplement to Trip Report Inclosed:

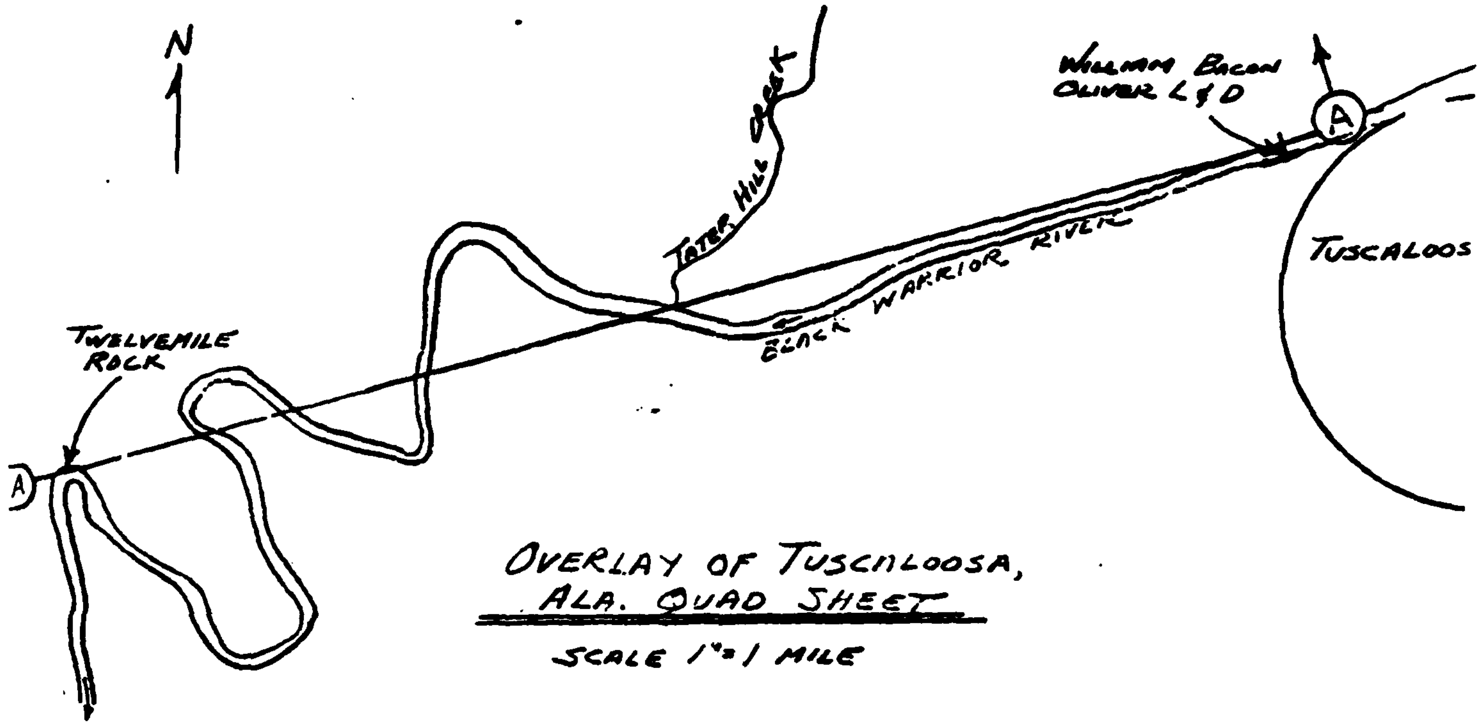
Based on the rock information presented by Mr. Bryan and covered in the trip report inclosed, the feasibility of locating the new lock and dam was confined to the three preliminary sites above Tater Hill Creek. Site 2 would have the lock located into the left abutment and immediately downstream of the Hunt Oil Company. This site was eliminated from further consideration because the docking facilities of the oil company would interfere with navigation in the upper approach.

Site 3 would have the lock located into the right bank above Tater Hill Creek. The site was judged to be acceptable. The approaches to the lock would be good and the lock could be located sufficiently landward to be constructed within an earth cofferdam.

Site 1 would have the axis of the dam located about 2700 feet downstream of the existing project. The lock would be located in the right bank. When the present spillway is removed, the upstream spillway approach in the right abutment would function as an acceptable upstream approach to the new lock. Site 1 was considered to be the best of the 3 sites inspected. There could be some interference to navigation during the construction period and a more detailed investigation beyond the scope of this investigation will be necessary.

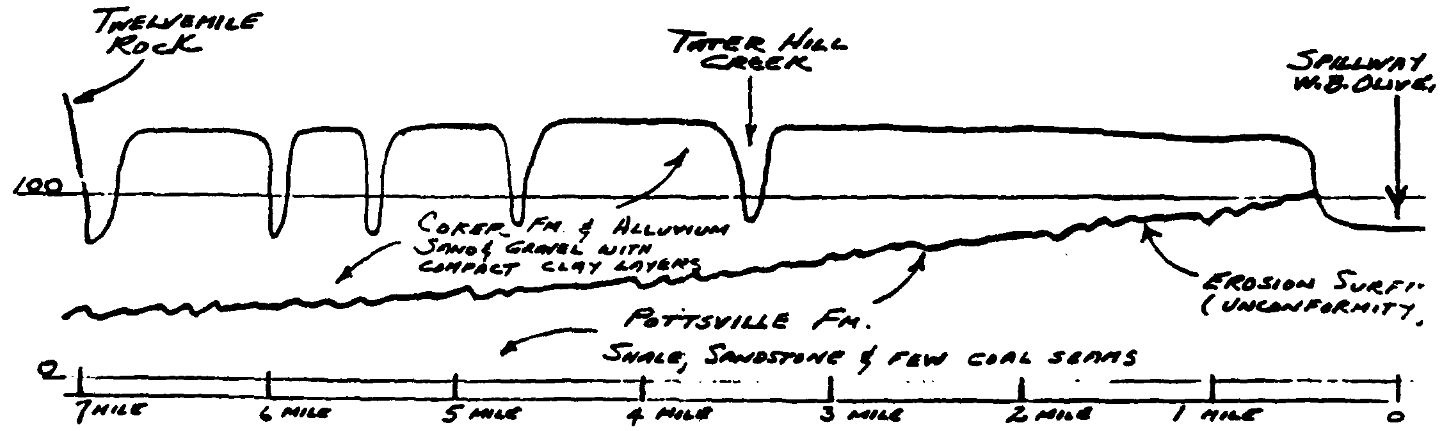
A recommendation to obtain geologic information by drilling at both Sites 3 and 1 was made. The Civil Engineering Section of the Design Branch will prepare the layouts for the three borings at each site.

A. F. BAKR
Supvg. Structural Engineer



OVERLAY OF TUSCALOOSA,
ALA. QUAD SHEET

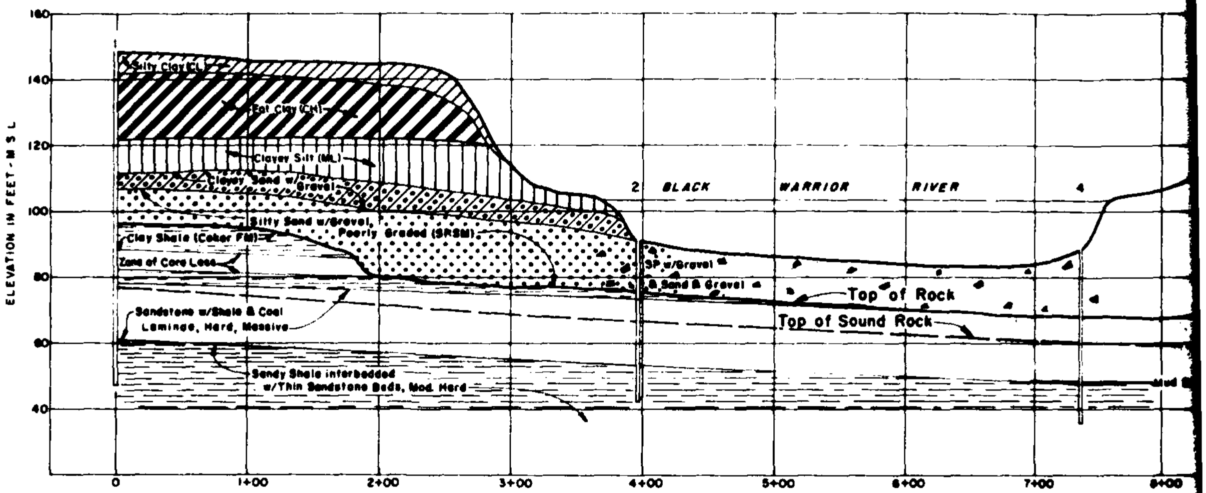
SCALE 1" = 1 MILE



GEOLOGIC PROFILE A-A

VERTICAL SCALE 1" = 150 FT.

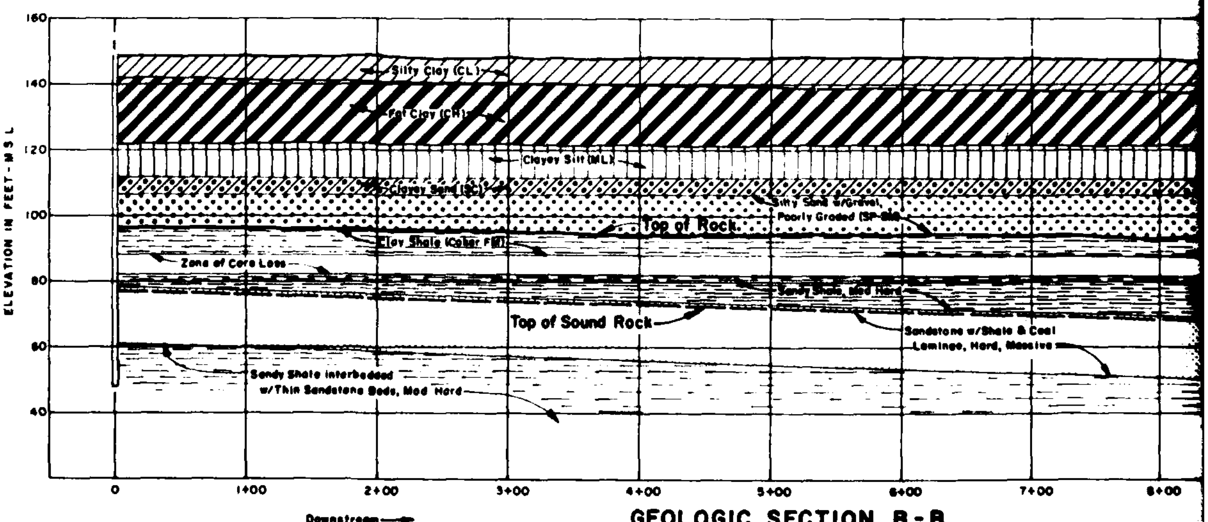
HORIZONTAL SCALE 1" = .. MILE



GEOLOGIC SECTION A-A

(Looking Upstream)

SCALE 1" = 50' HORIZONTAL
1" = 20' VERTICAL



GEOLOGIC SECTION B-B

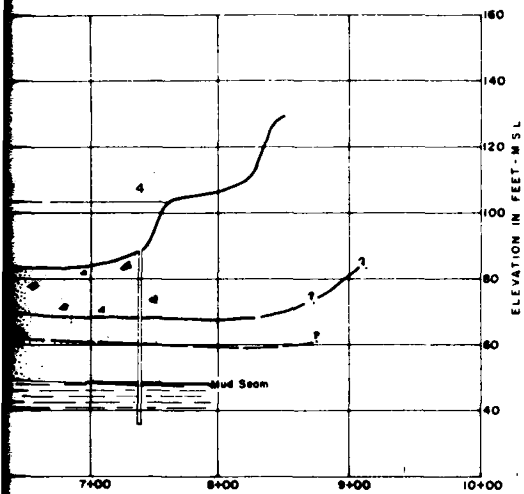
(Looking South Toward River)

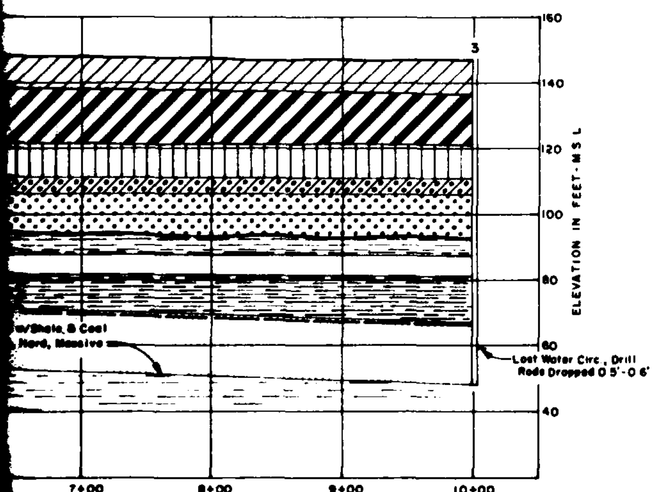
SCALE 1" = 50' HORIZONTAL
1" = 20' VERTICAL

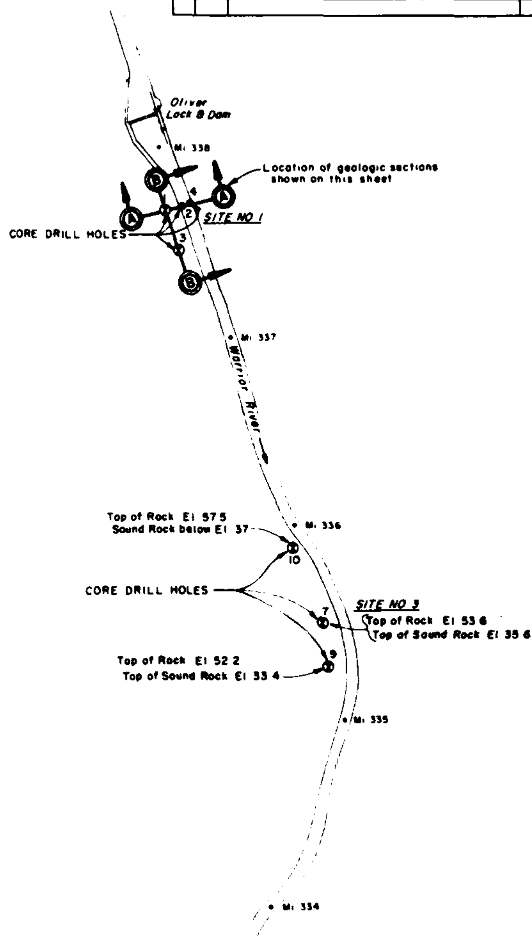
U. S. ARMY

REVISIONS

SYM	ZONE	DESCRIPTION	DATE	APPROVED







PLAN OF BORINGS

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA

OLIVER LOCK REPLACEMENT
WARRIOR RIVER, ALA.

PLAN OF BORINGS AND GEOLOGIC SECTIONS

APPENDIX A, CHART II-1

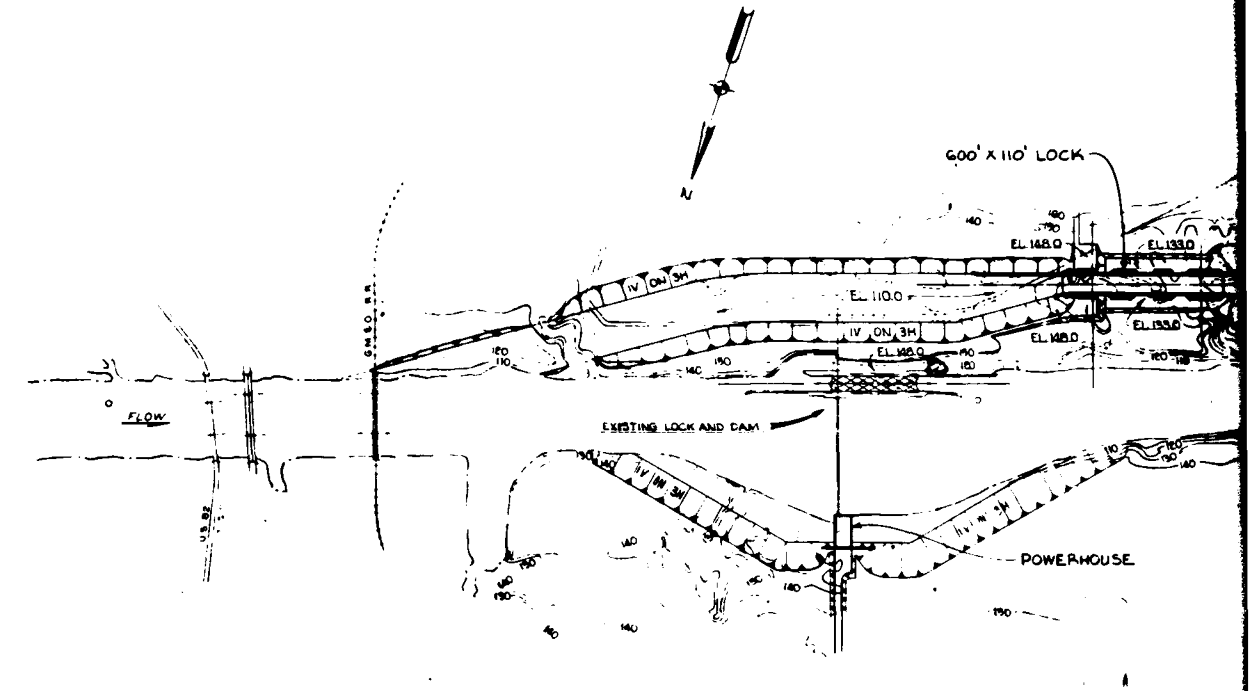
APPENDIX A

SECTION III

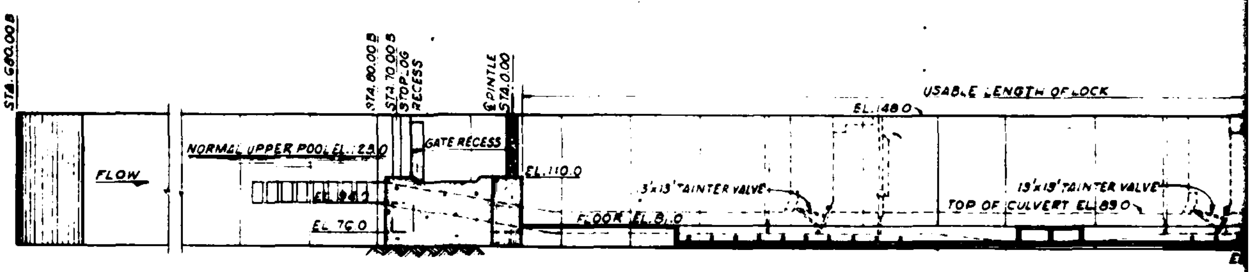
ALTERNATIVE DESIGNS

The following drawings depict the various alternatives examined in the interim report. Each plan is shown with both a lock and a powerhouse. The proposed disposal areas are located on the north side of the river about a half-mile from the construction site. Haul roads are not shown. Also not shown are access to the hydropower plant and transmission lines.

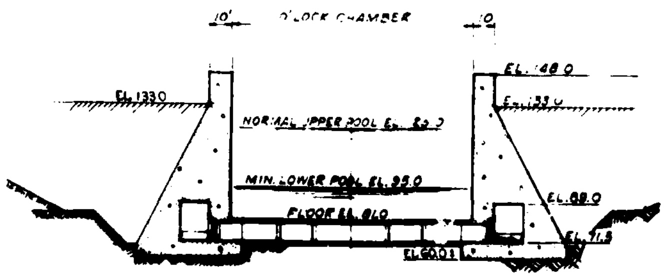
CORPS OF ENGINEERS | 4 | 3



PLAN
SCALE: 1" = 400'



LONGITUDINAL SECTION THROUGH LOCK
SCALE: 1" = 40'



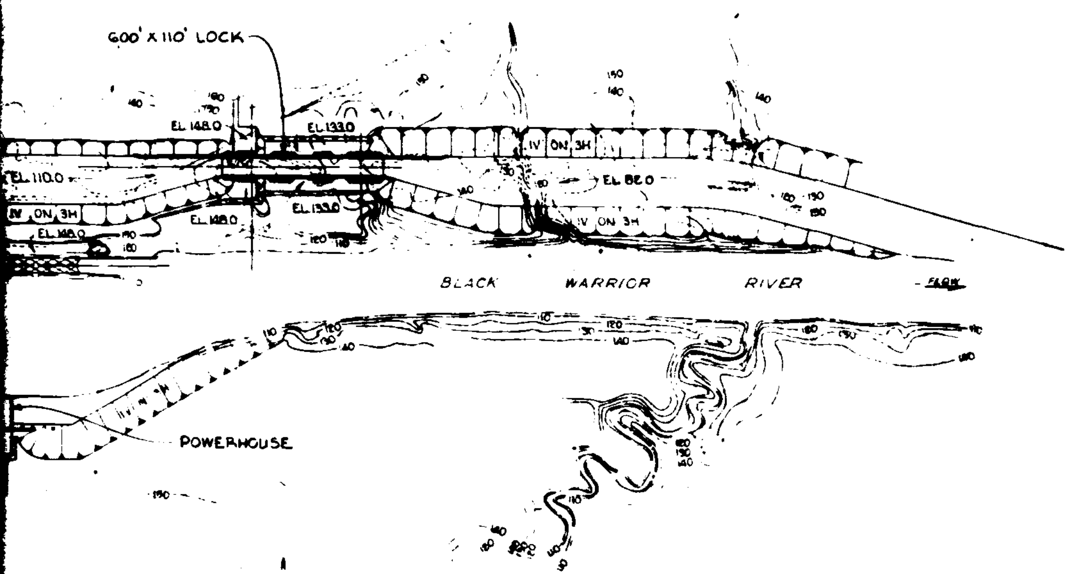
TYPICAL LOCK SECTION
SCALE: 1" = 50'

5 | 4 | 3

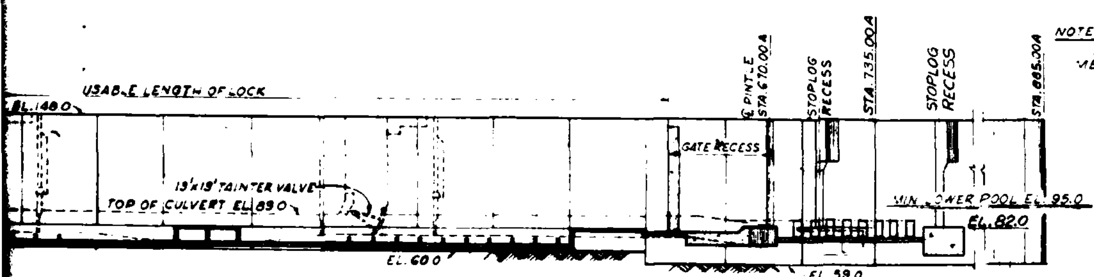
3 2 1 U. S. ARMY

REVISIONS

SYM	ZONE	DESCRIPTION	DATE	APPROVED



PLAN
SCALE: 1" = 400'



SECTION THROUGH LOCK
SCALE: 1" = 40'

NOTES:
ELEVATIONS ARE IN FEET AND REFER TO MEAN SEA LEVEL.

SCALE: 1" = 30'
SCALE: 1" = 40'
SCALE: 1" = 400'

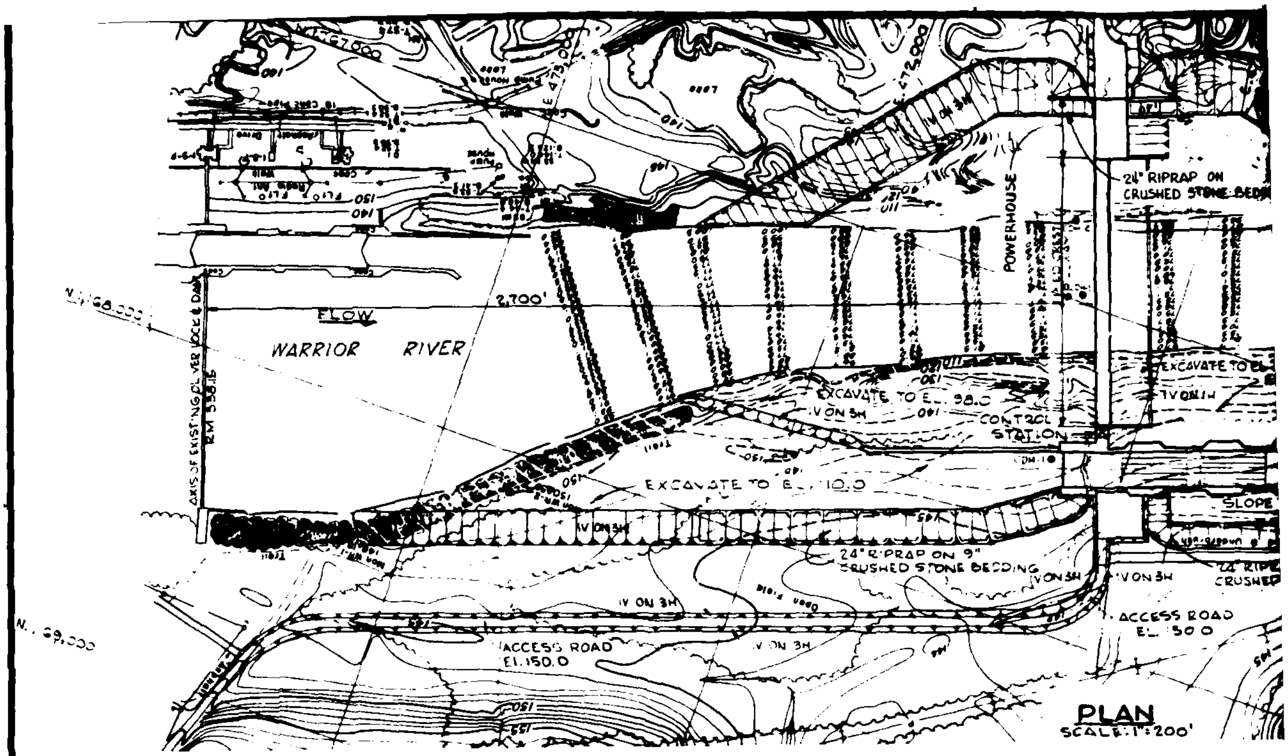
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

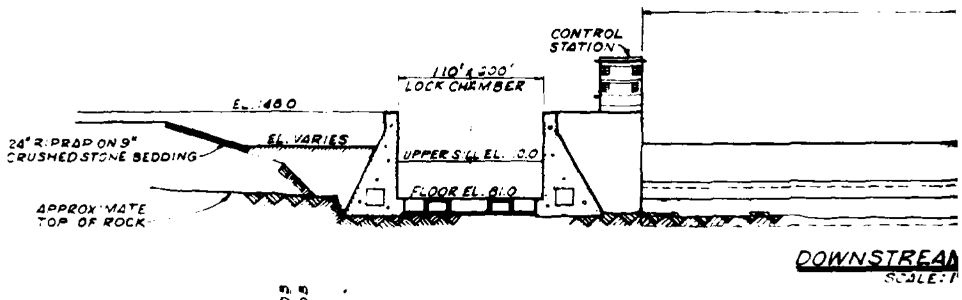
BLACK WARRIOR - TOMBIGBEE RIVERS, ALABAMA
OLIVER LOCK REPLACEMENT
ALTERNATIVE NO. I

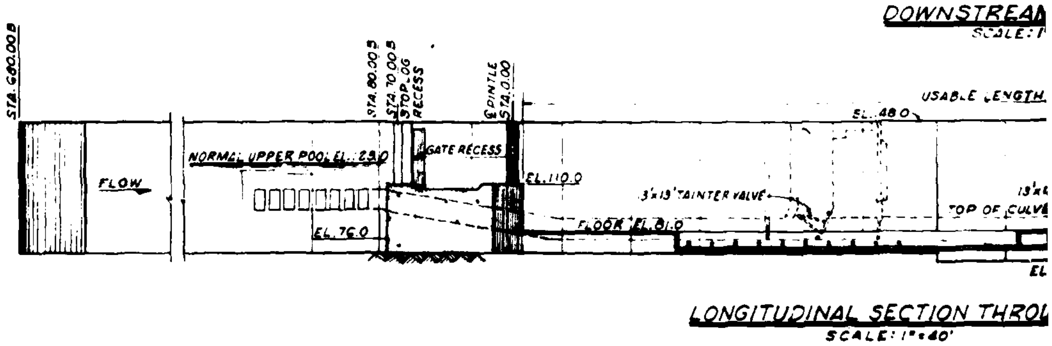
3 2 1

APPENDIX A, CHART III-1

1 2

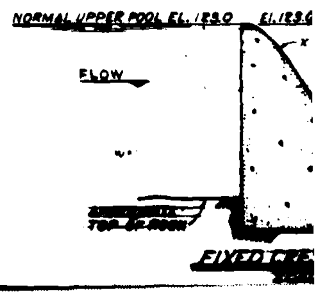


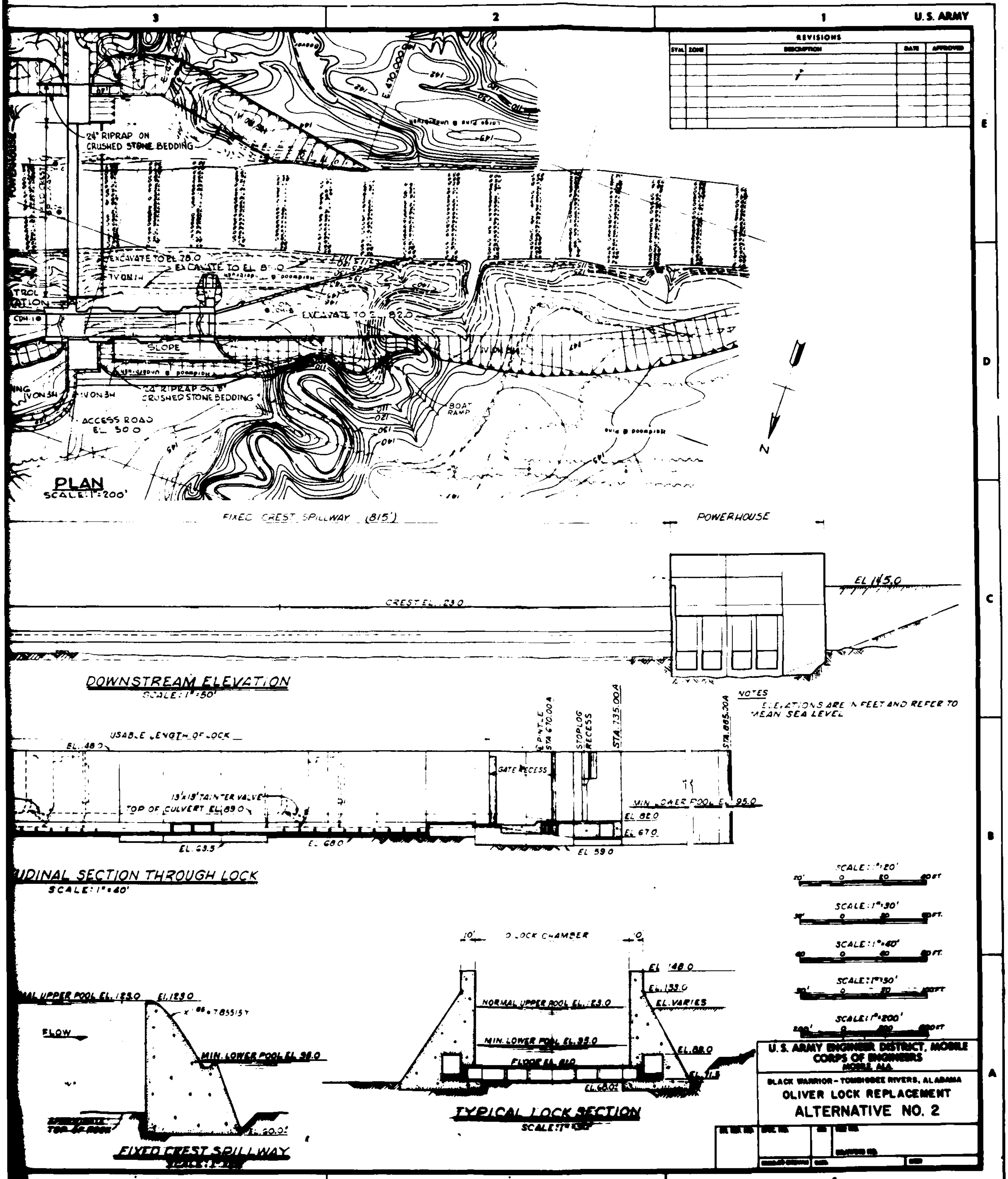




RECOMMENDED PLAN

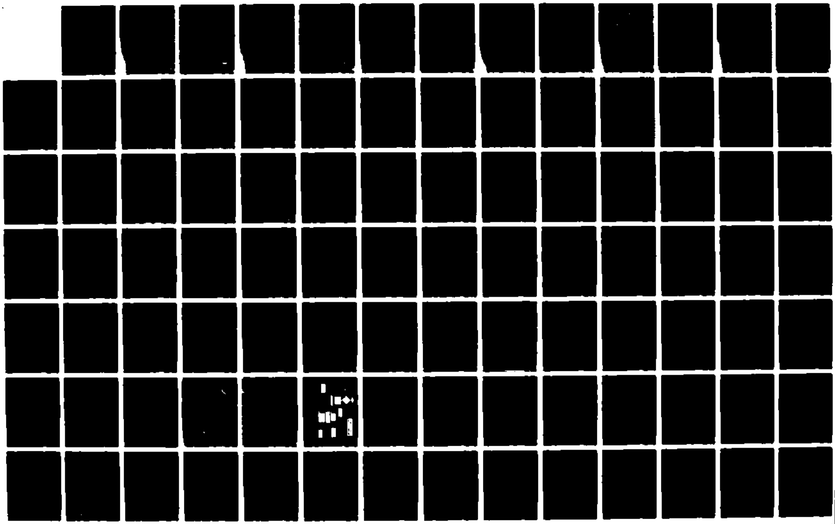
PLATE 1




U.S. ARMY
REVISIONS
24" RIPRAP ON CRUSHED STONE BEDDING
EXCAVATE TO EL 28.0
EXCAVATE TO EL 82.0
SLOPE
24" RIPRAP ON 8" CRUSHED STONE BEDDING
ACCESS ROAD EL 30.0
BOAT RAMP
N
PLAN
SCALE: 1"=200'
FIXED CREST SPILLWAY (815')
POWERHOUSE
EL 145.0
CREST EL 123.0
DOWNSTREAM ELEVATION
SCALE: 1"=50'
NOTES
ELEVATIONS ARE IN FEET AND REFER TO MEAN SEA LEVEL
USABLE LENGTH OF LOCK
EL 148.0
GATE RECESS
STOPLOG RECESS
STA 735.00A
STA 885.30A
13'x13' TAINTER VALVE
TOP OF CULVERT EL 89.0
MIN. LOWER POOL EL 95.0
EL 82.0
EL 67.0
EL 68.0
EL 59.0
LONGITUDINAL SECTION THROUGH LOCK
SCALE: 1"=40'
SCALE: 1"=20'
SCALE: 1"=30'
SCALE: 1"=40'
SCALE: 1"=50'
SCALE: 1"=200'
LOCK CHAMBER
NORMAL UPPER POOL EL 123.0
EL 123.0
FLOW
MIN. LOWER POOL EL 95.0
FIXED CREST SPILLWAY
EL 148.0
EL 139.0
EL VARIES
NORMAL UPPER POOL EL 123.0
MIN. LOWER POOL EL 95.0
FLOOR EL 81.0
EL 88.0
TYPICAL LOCK SECTION
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.
BLACK WARRIOR - TOMBIGBEE RIVERS, ALABAMA
OLIVER LOCK REPLACEMENT
ALTERNATIVE NO. 2

AD-A138 450 INTERIM FEASIBILITY REPORT AND ENVIRONMENTAL IMPACT STATEMENT FOR OLIVER..(U) CORPS OF ENGINEERS MOBILE AL MOBILE DISTRICT DEC 83 COESAM/PDW-83/001 3/6

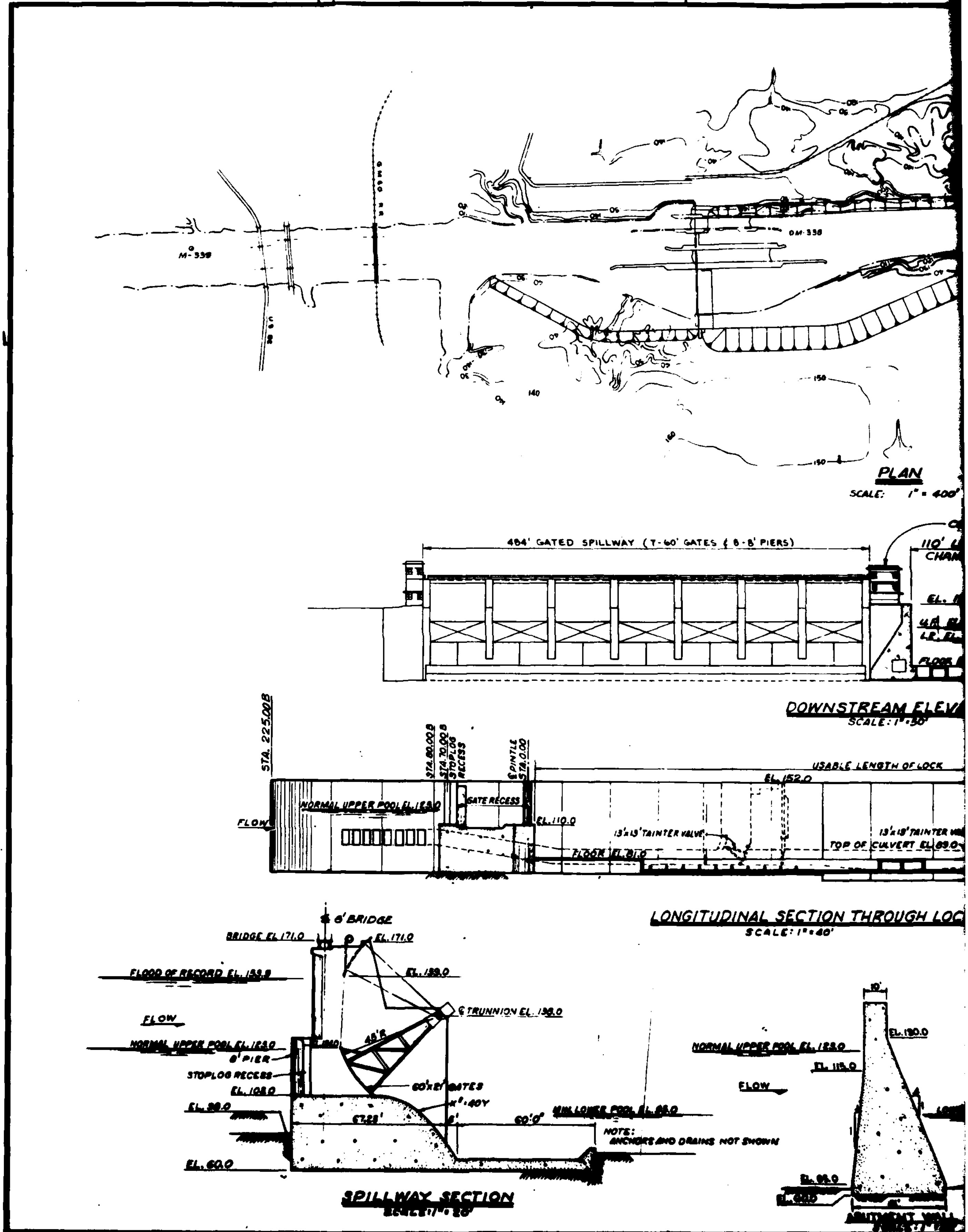
UNCLASSIFIED F/G 13/2 NL



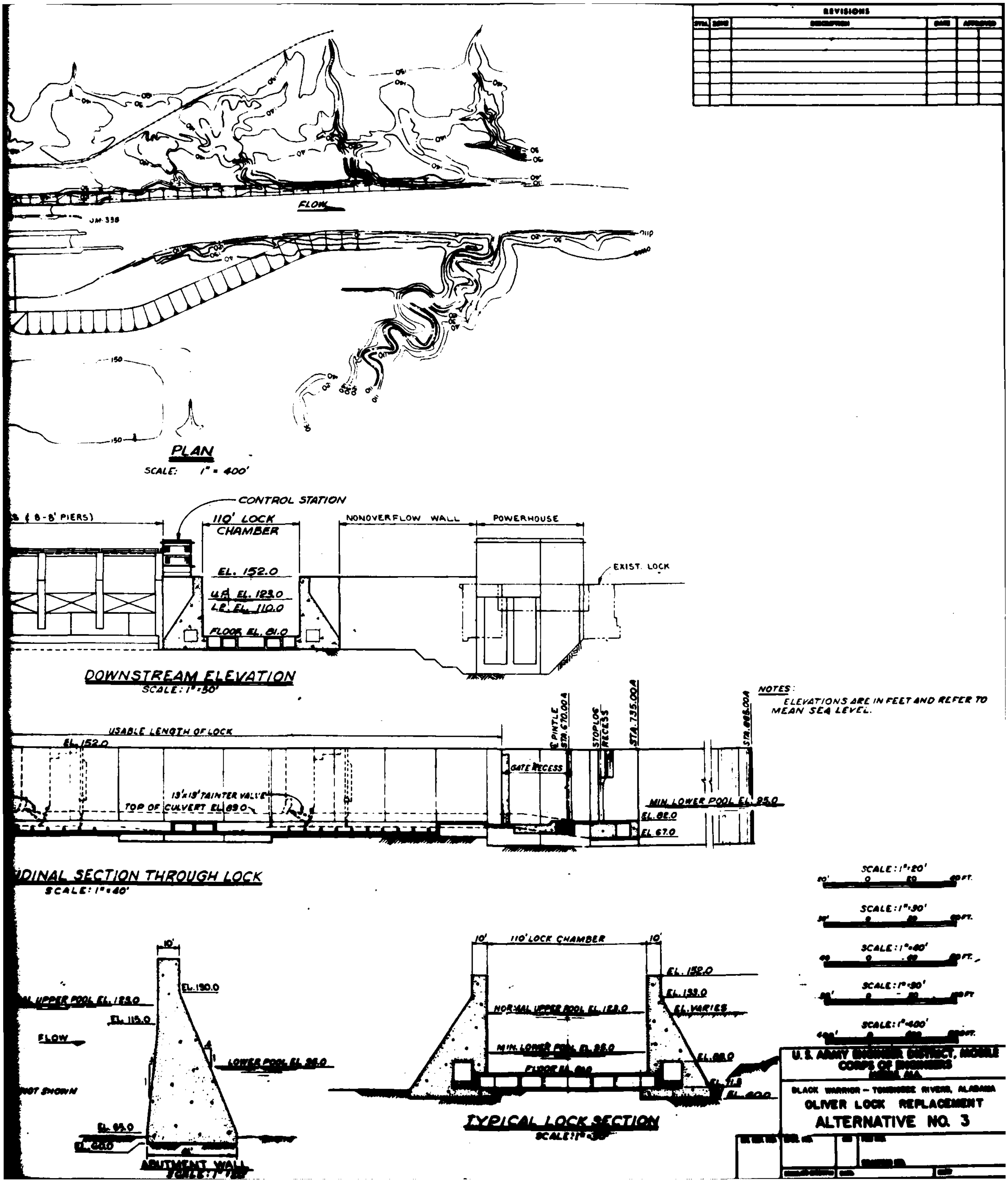
1.0 1.1 1.25 1.4 1.6 1.8 2.0 2.2 2.5 2.8 3.2 3.6 4.0 4.5 5.0 5.6 6.3

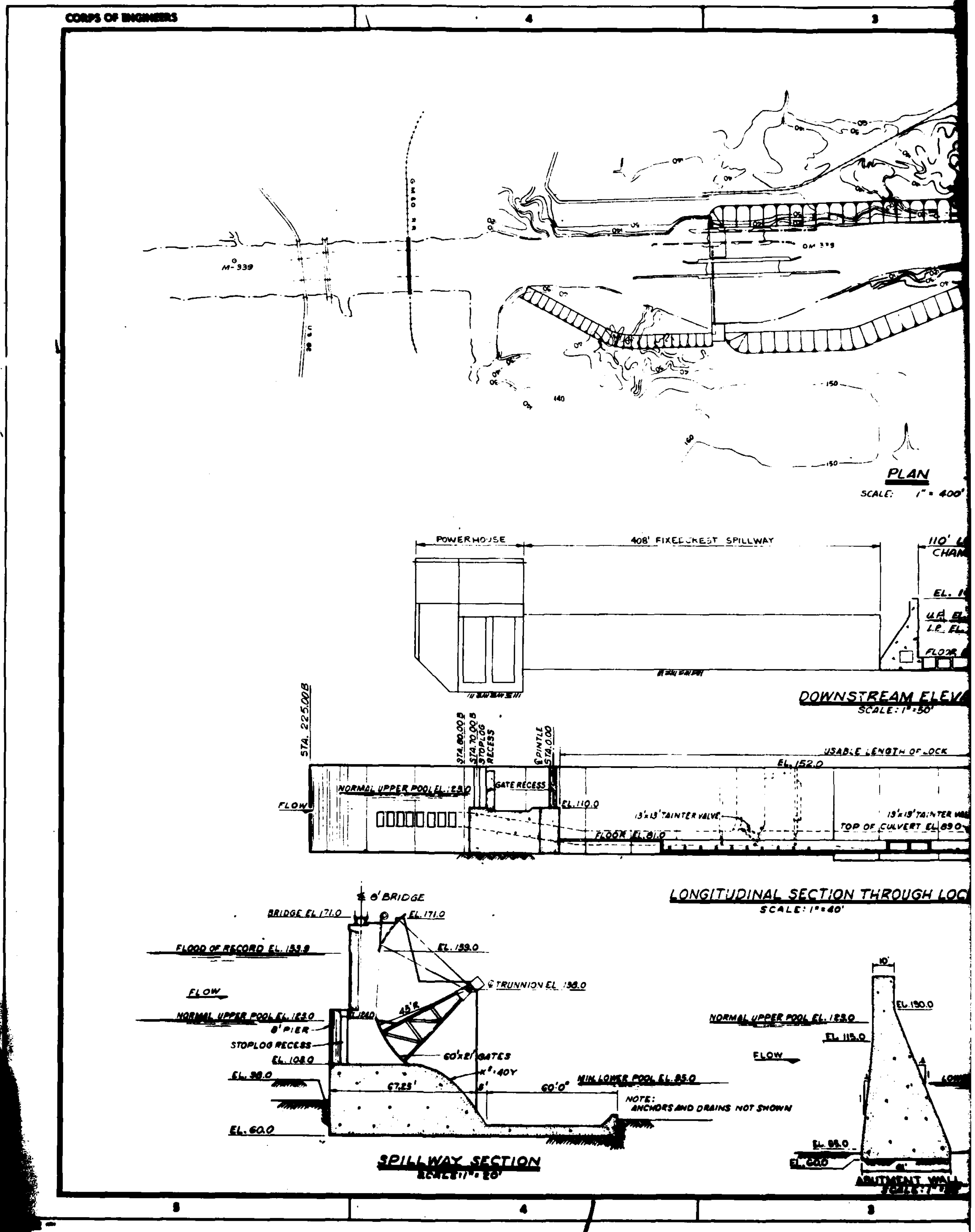
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

CORPS OF ENGINEERS

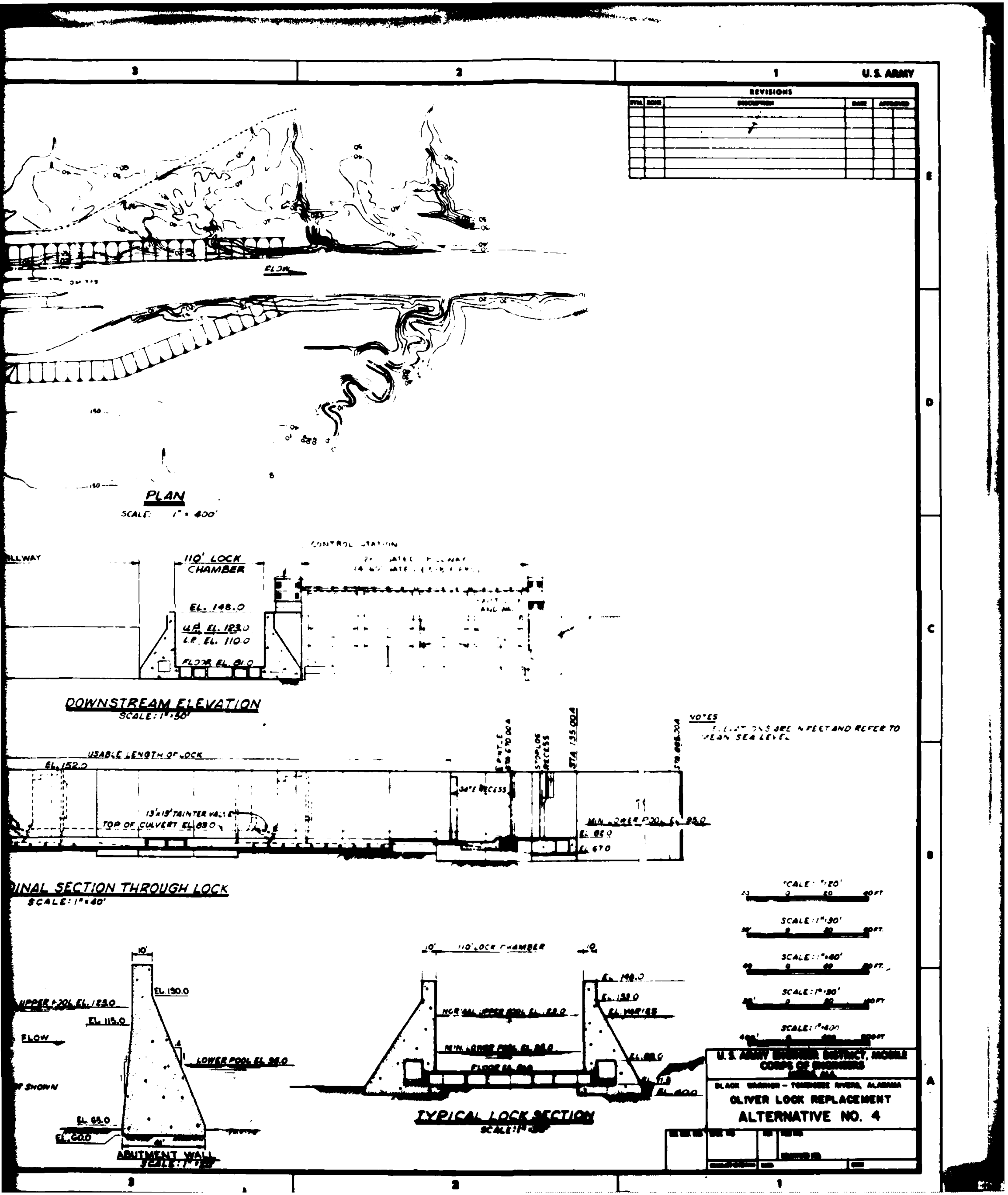


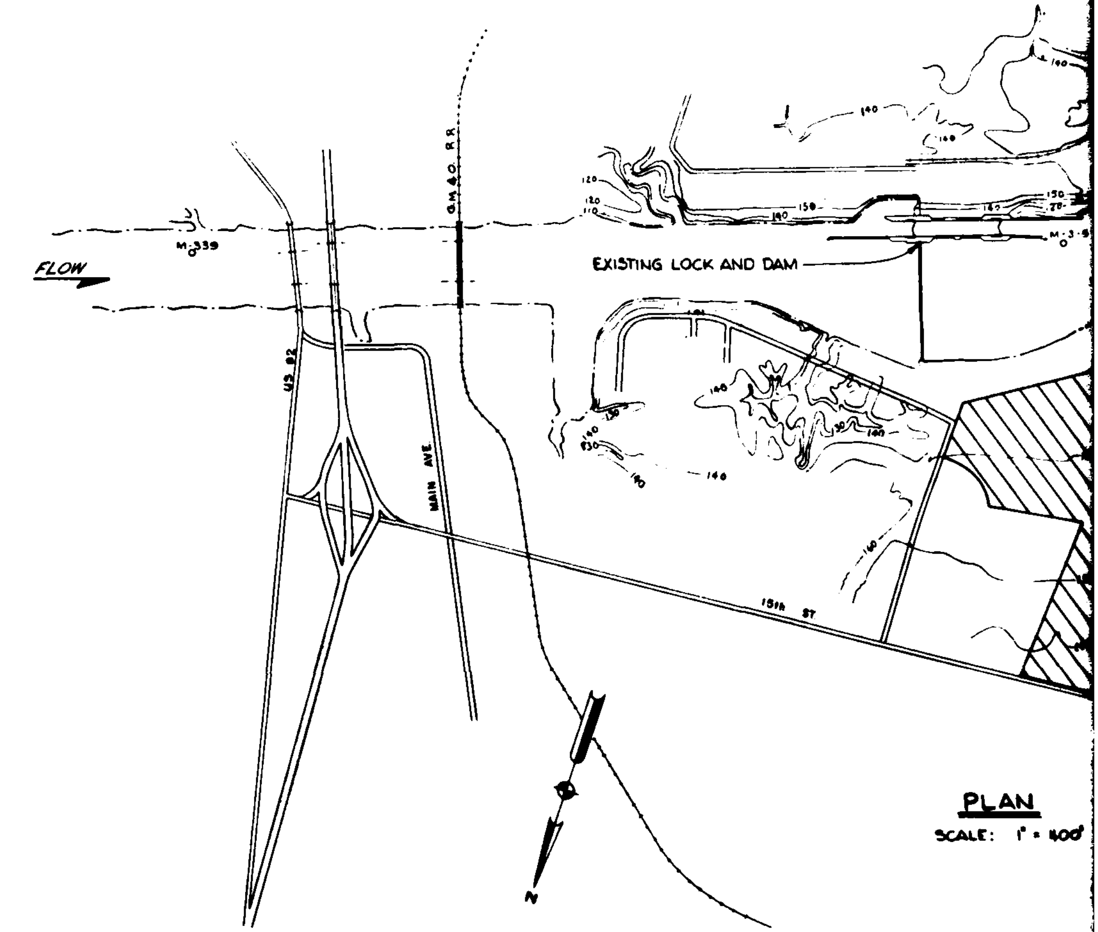
5
4
3


REVISIONS
FLOW
PLAN
SCALE: 1" = 400'
CONTROL STATION
(8-8' PIERS)
110' LOCK CHAMBER
NONOVERFLOW WALL
POWERHOUSE
EXIST. LOCK
EL. 152.0
U.P. EL. 123.0
L.P. EL. 110.0
FLOOR EL. 81.0
DOWNSTREAM ELEVATION
SCALE: 1"=50'
NOTES:
ELEVATIONS ARE IN FEET AND REFER TO MEAN SEA LEVEL.
USABLE LENGTH OF LOCK
EL. 152.0
℄ PINTLE STA. 670.00A
STOPLOG RECESS
STA. 735.00A
STA. 885.00A
GATE RECESS
13'x13' TAINTER VALVE
TOP OF CULVERT EL. 89.0
MIN. LOWER POOL EL. 95.0
EL. 82.0
EL. 67.0
DINAL SECTION THROUGH LOCK
SCALE: 1"=40'
SCALE: 1"=20'
SCALE: 1"=30'
SCALE: 1"=60'
SCALE: 1"=50'
SCALE: 1"=400'
10'
EL. 130.0
UPPER POOL EL. 123.0
EL. 115.0
FLOW
LOWER POOL EL. 95.0
NOT SHOWN
EL. 65.0
EL. 60.0
ABUTMENT WALL
110' LOCK CHAMBER
EL. 152.0
EL. 133.0
EL. VARIES
NORMAL UPPER POOL EL. 123.0
MIN. LOWER POOL EL. 95.0
EL. 88.0
FLOOR EL. 81.0
EL. 60.0
TYPICAL LOCK SECTION
SCALE: 1"=30'
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
BLACK WARRIOR - TOMBIGBEE RIVERS, ALABAMA
OLIVER LOCK REPLACEMENT
ALTERNATIVE NO. 3

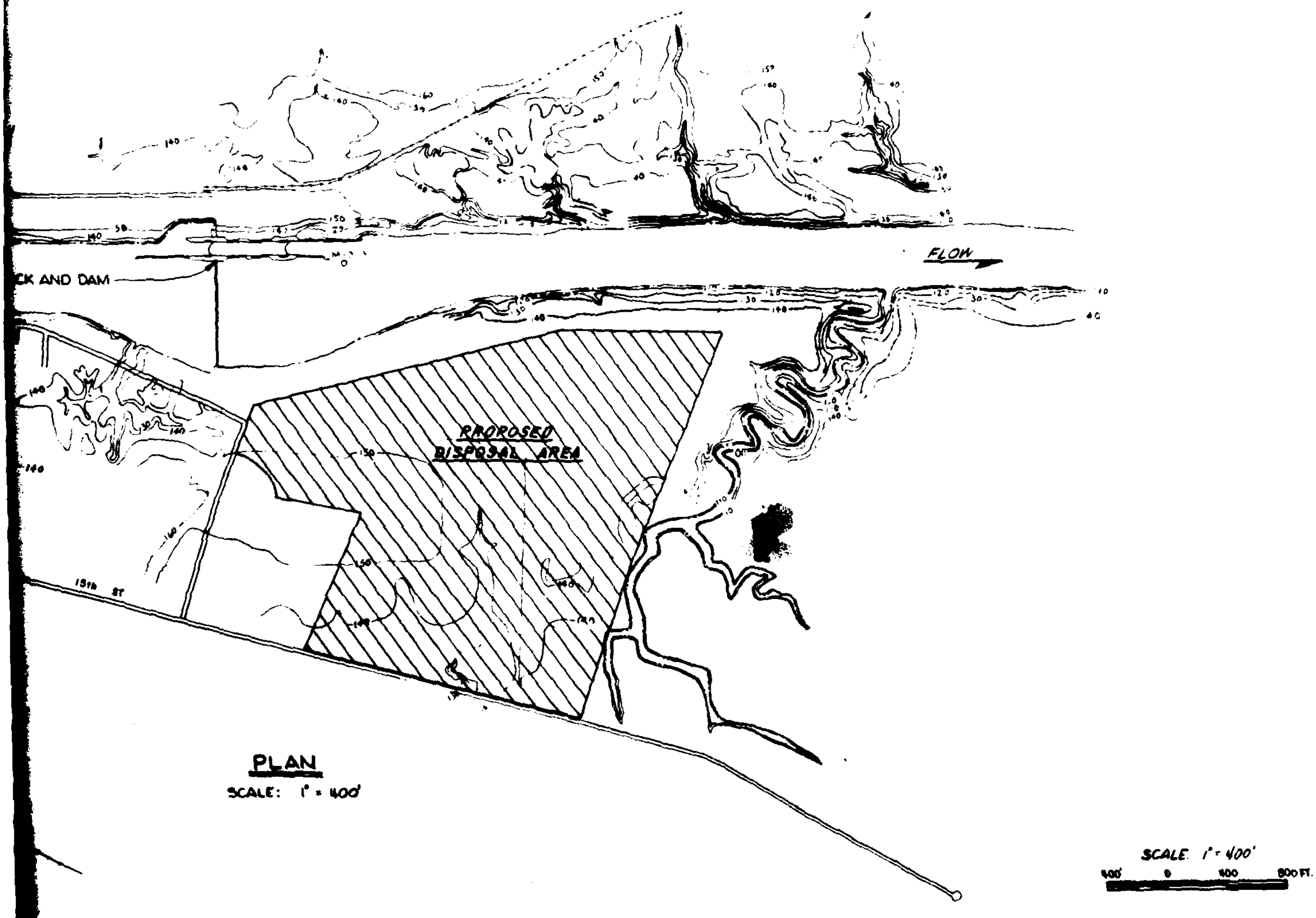


CORPS OF ENGINEERS
4
3
PLAN
SCALE: 1" = 400'
POWERHOUSE
408' FIXED CREST SPILLWAY
DOWNSTREAM ELEV
SCALE: 1"=50'
STA. 225.00B
STA. 80.00 B
STA. 70.00 B
STOPLOG RECESS
℄ PINTLE STA. 0.00
USABLE LENGTH OF LOCK
EL. 152.0
NORMAL UPPER POOL EL. 123.0
GATE RECESS
FLOW
EL. 110.0
13'x13' TAINTER VALVE
FLOOR EL. 81.0
TOP OF CULVERT EL. 89.0
LONGITUDINAL SECTION THROUGH LOC
SCALE: 1"=40'
℄ 8' BRIDGE
BRIDGE EL. 171.0
EL. 171.0
FLOOD OF RECORD EL. 153.9
EL. 159.0
℄ TRUNNION EL. 138.0
FLOW
NORMAL UPPER POOL EL. 123.0
8' PIER
STOPLOG RECESS
EL. 108.0
60'x21' GATES
EL. 98.0
67.25'
60'0"
MIN. LOWER POOL EL. 85.0
NOTE:
ANCHORS AND DRAINS NOT SHOWN
EL. 60.0
SPILLWAY SECTION
SCALE: 1"=20'
10'
EL. 190.0
NORMAL UPPER POOL EL. 123.0
EL. 115.0
FLOW
EL. 85.0
EL. 60.0
ABUTMENT WALL
5
4
3


U.S. ARMY
REVISIONS
FLOW
PLAN
SCALE: 1" = 400'
CONTROL STATION
110' LOCK CHAMBER
EL. 148.0
U.P. EL. 123.0
L.P. EL. 110.0
FLOOR EL. 81.0
DOWNSTREAM ELEVATION
SCALE: 1"=30'
USABLE LENGTH OF LOCK
EL. 152.0
GATE RECESS
STOPLOG RECESS
STA 135 00.0
13'x13' TAINTER VALVE
TOP OF CULVERT EL. 89.0
MIN. LOWER POOL EL. 95.0
EL. 67.0
NOTES
ELEVATIONS ARE IN FEET AND REFER TO MEAN SEA LEVEL
...INAL SECTION THROUGH LOCK
SCALE: 1"=40'
SCALE: 1"=30'
SCALE: 1"=40'
SCALE: 1"=400
10'
110' LOCK CHAMBER
EL. 148.0
NORMAL UPPER POOL EL. 123.0
MIN. LOWER POOL EL. 95.0
FLOOR EL. 81.0
EL. VARIES
EL. 60.0
TYPICAL LOCK SECTION
UPPER POOL EL. 123.0
EL. 130.0
EL. 115.0
FLOW
LOWER POOL EL. 95.0
EL. 65.0
EL. 60.0
ABUTMENT WALL
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
BLACK WARRIOR – TOMBIGBEE RIVERS, ALABAMA
OLIVER LOCK REPLACEMENT
ALTERNATIVE NO. 4



FLOW
EXISTING LOCK AND DAM
US 82
MAIN AVE.
15th ST
G.M.&O. R.R.
N
PLAN
SCALE: 1" = 400'

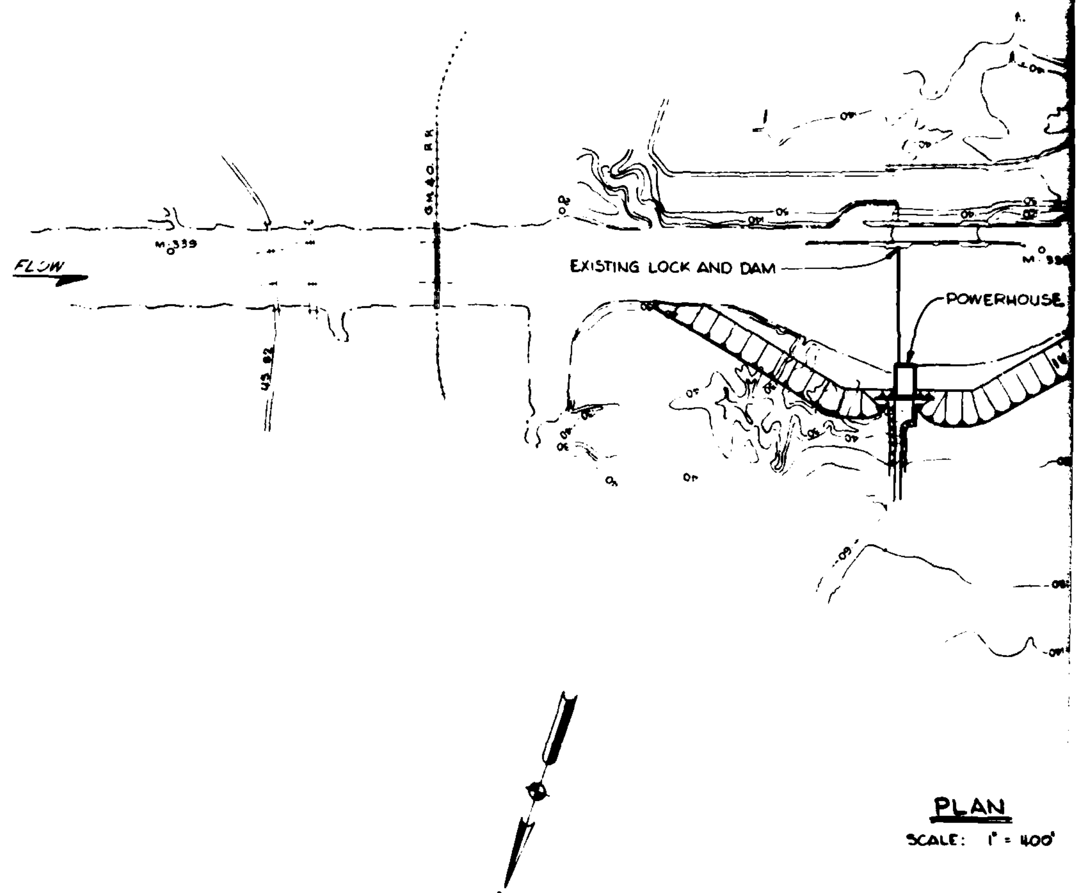


U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

BLACK WARRIOR - TOMBIGBEE RIVERS, ALABAMA

OLIVER LOCK REPLACEMENT

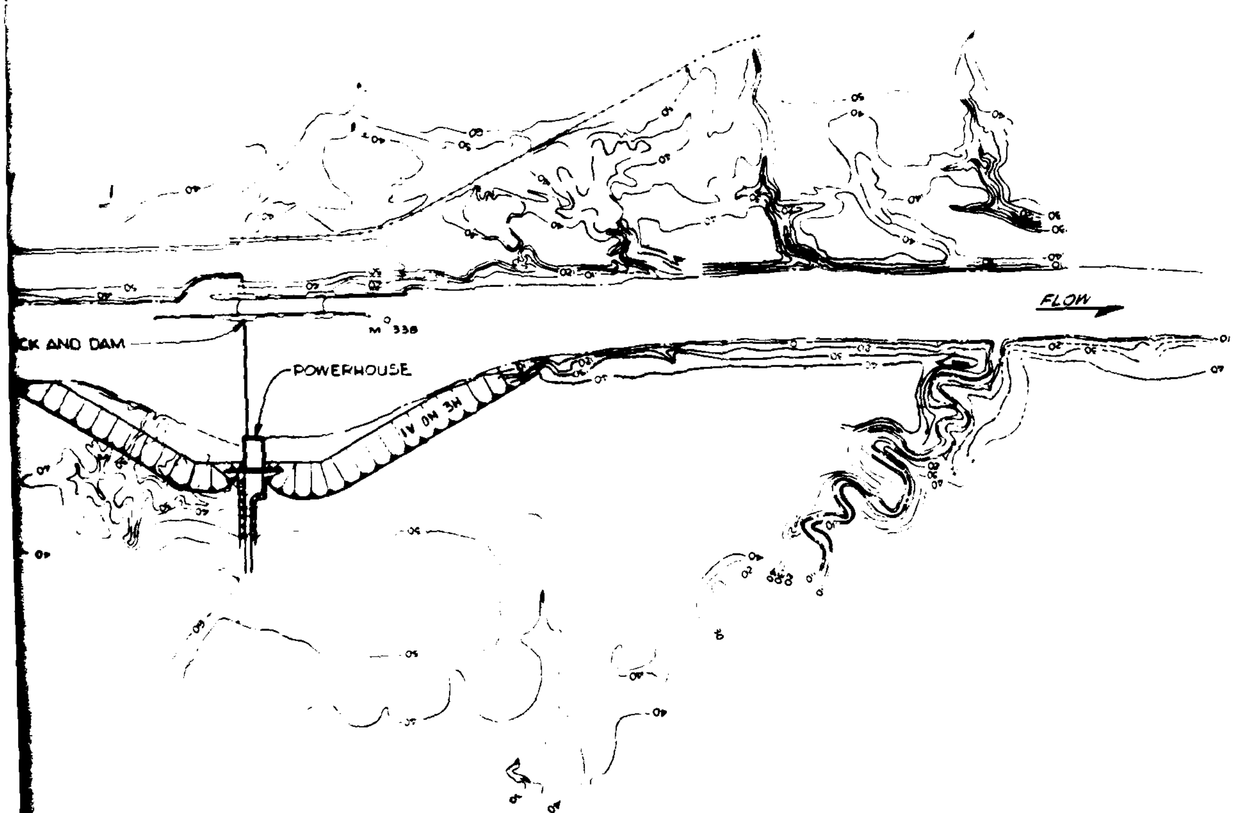
PROPOSED DISPOSAL AREA



PLAN

SCALE: 1" = 400'

REVISIONS



PLAN

SCALE: 1" = 400'

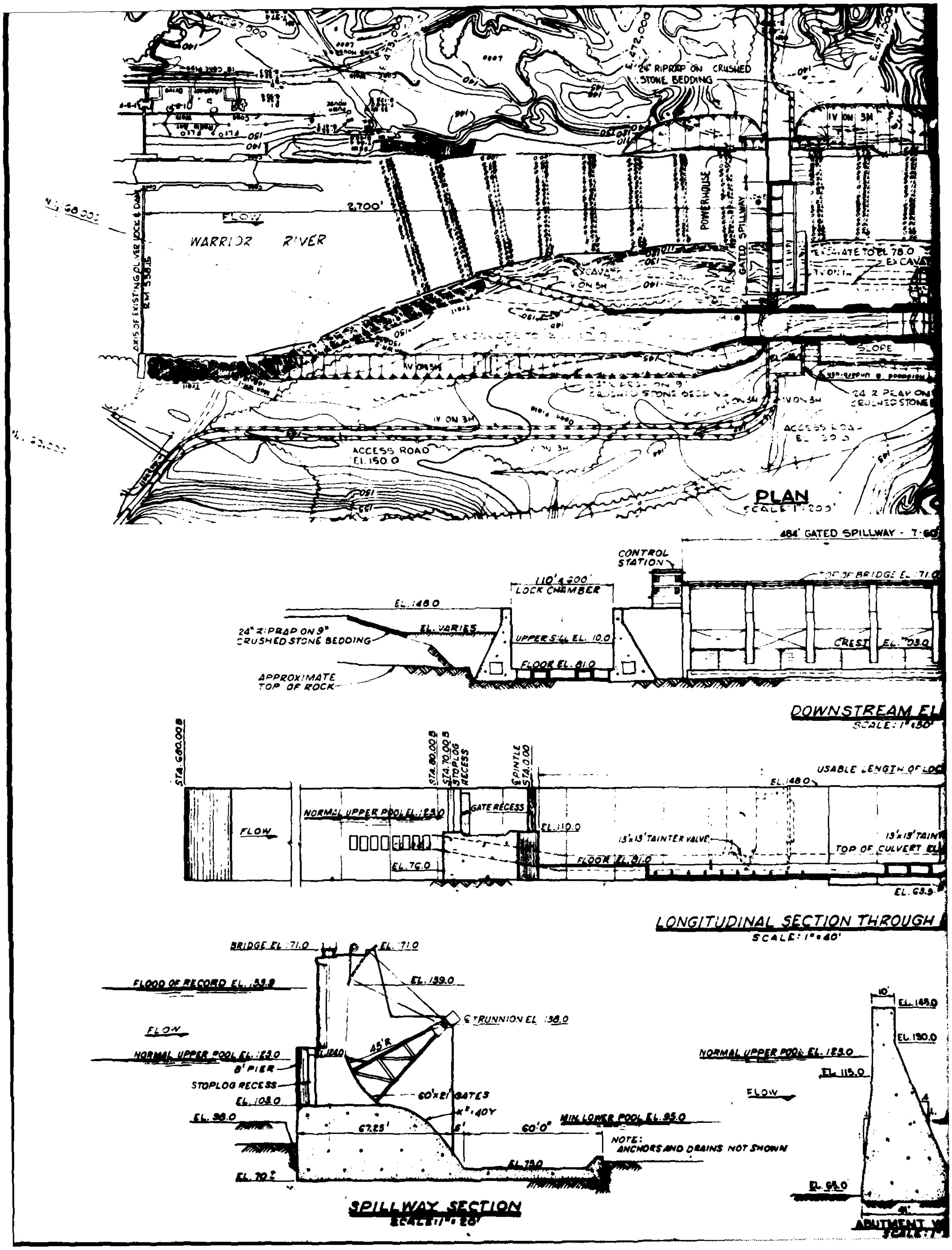
SCALE: 1" = 400'
400' 0 400 800 FT.

U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

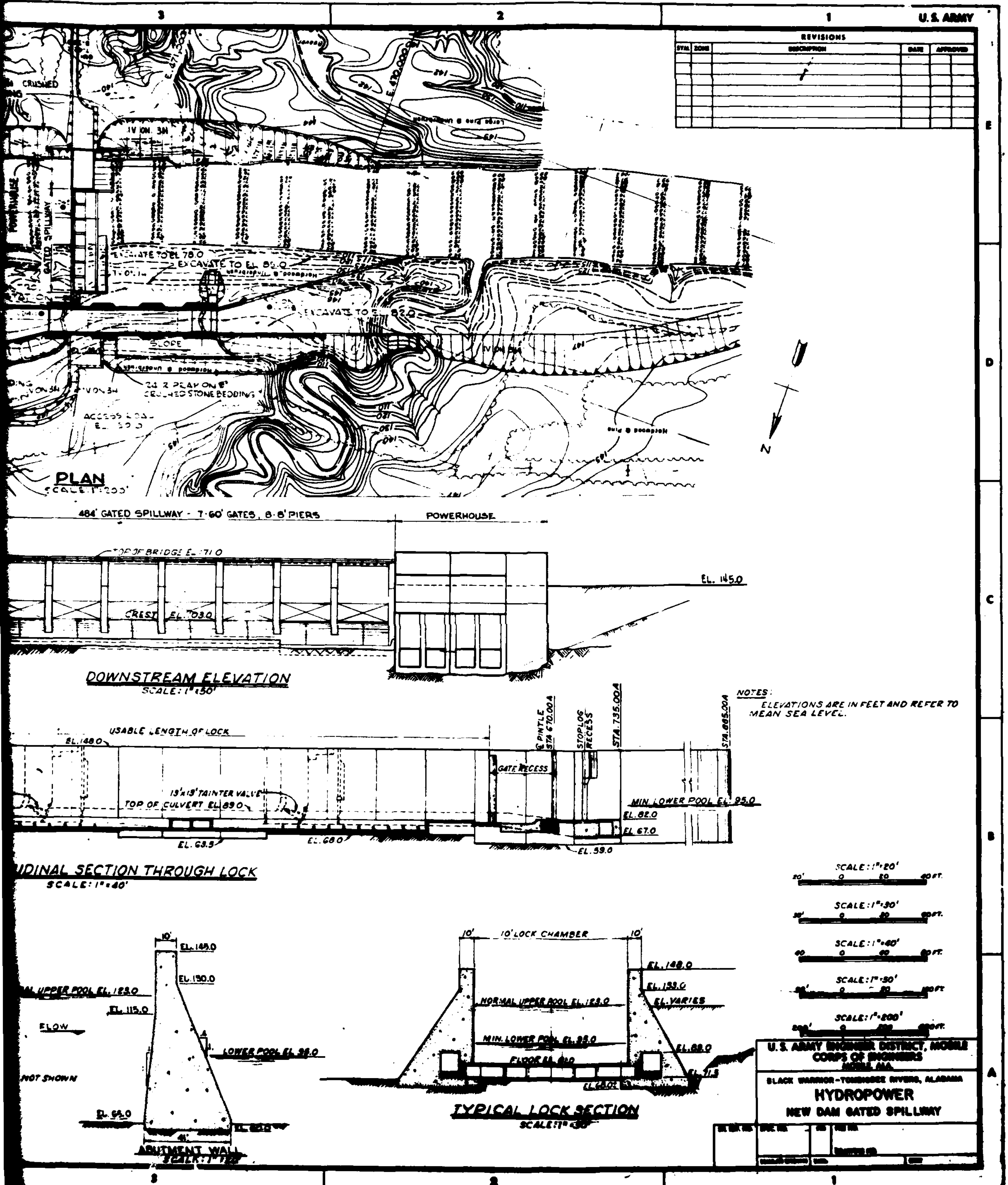
BLACK WARRIOR - TOMBIGBEE RIVERS, ALABAMA

HYDROPOWER

EXISTING DAM

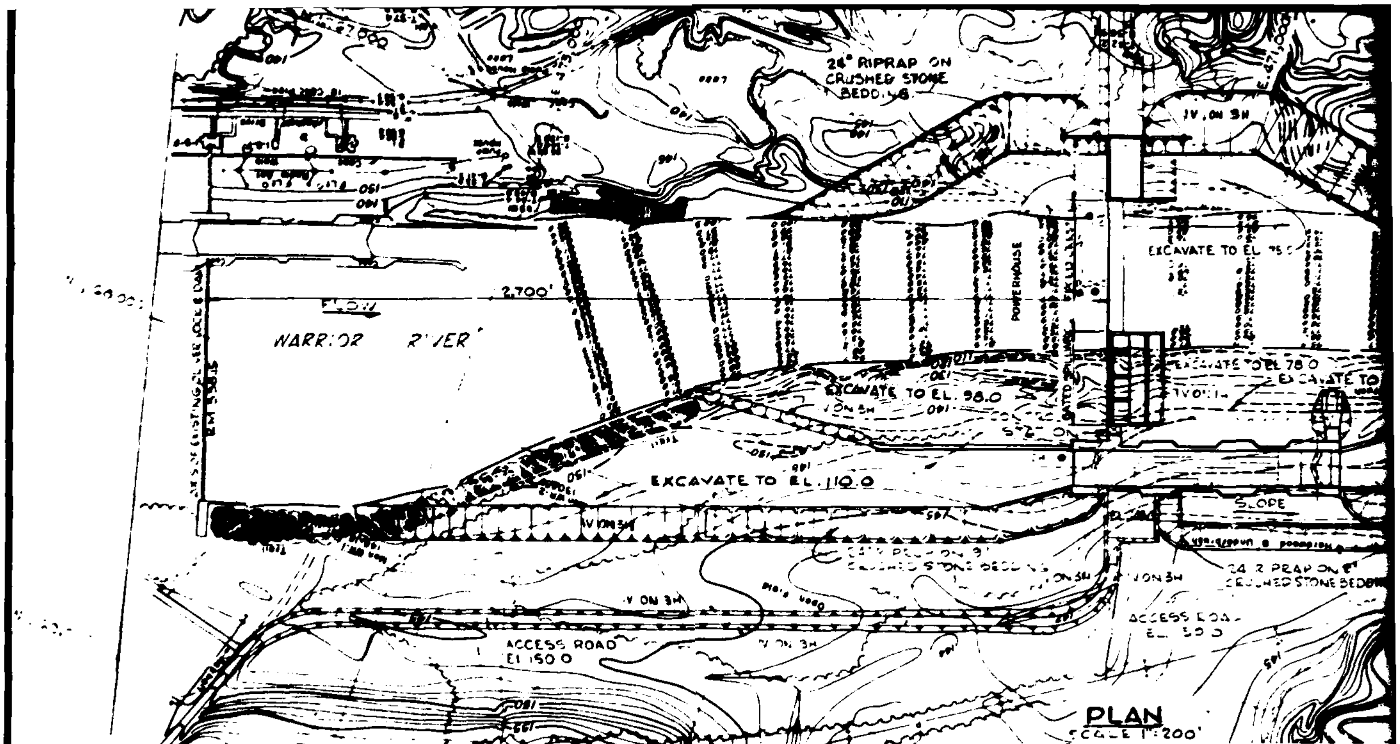


24" RIPRAP ON CRUSHED STONE BEDDING
POWERHOUSE
GATED SPILLWAY
FLOW
WARRIOR RIVER
2,700'
AXIS OF EXISTING OLIVER LOCK & DAM
ACCESS ROAD EL. 150.0
PLAN
484' GATED SPILLWAY
CONTROL STATION
110' x 600' LOCK CHAMBER
EL. 148.0
EL. VARIES
24" RIPRAP ON 9" CRUSHED STONE BEDDING
APPROXIMATE TOP OF ROCK
FLOOR EL. 81.0
DOWNSTREAM EL
USABLE LENGTH OF LOC
NORMAL UPPER POOL EL. 123.0
GATE RECESS
STOPLOG RECESS
EL. 110.0
EL. 76.0
13'x13' TAINTER VALVE
TOP OF CULVERT EL
FLOOR EL. 81.0
LONGITUDINAL SECTION THROUGH
SCALE: 1"=40'
BRIDGE EL. 171.0
EL. 171.0
FLOOD OF RECORD EL. 153.8
EL. 159.0
℄ TRUNNION EL. 138.0
FLOW
NORMAL UPPER POOL EL. 123.0
8' PIER
STOPLOG RECESS
EL. 103.0
EL. 98.0
45'R
60'x21' GATES
67.25'
60'0"
MIN. LOWER POOL EL. 95.0
NOTE: ANCHORS AND DRAINS NOT SHOWN
EL. 73.0
EL. 70±
SPILLWAY SECTION
SCALE: 1"=20'
EL. 148.0
EL. 130.0
NORMAL UPPER POOL EL. 123.0
EL. 115.0
FLOW
EL. 68.0
ABUTMENT W

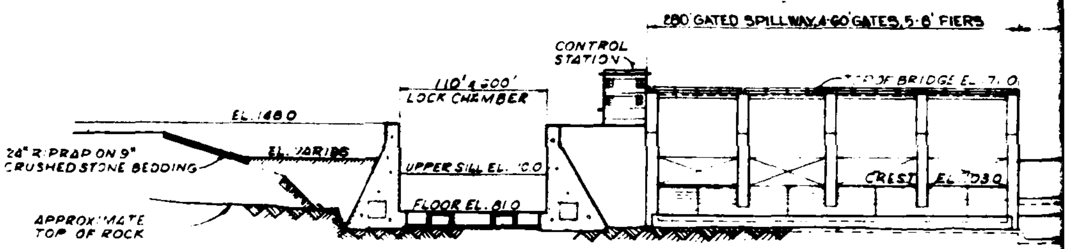


2

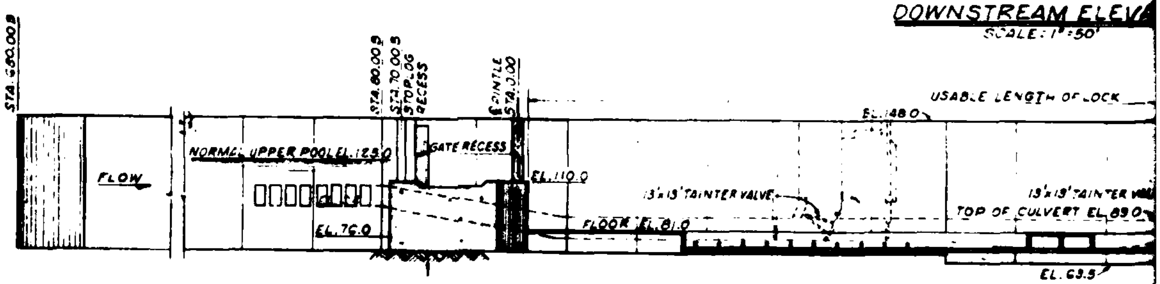
APPENDIX A, CHART III-7



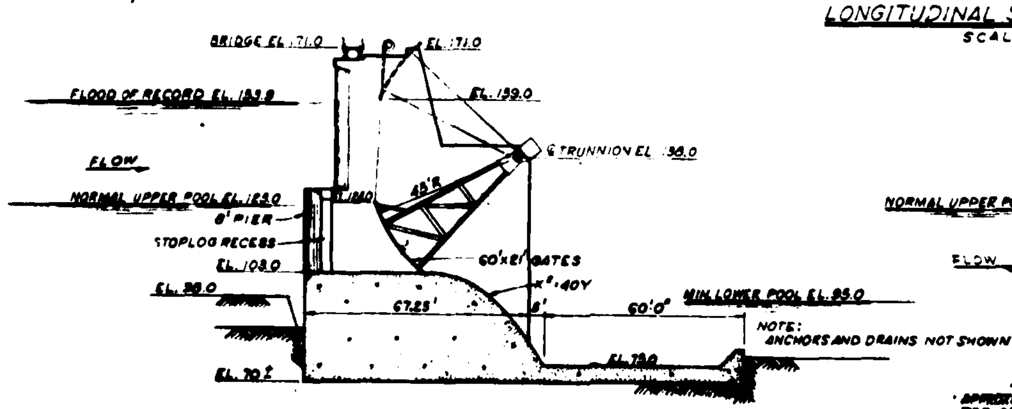
PLAN
SCALE 1"=200'



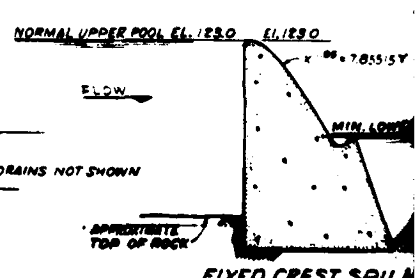
DOWNSTREAM ELEVA[TION]
SCALE: 1"=50'



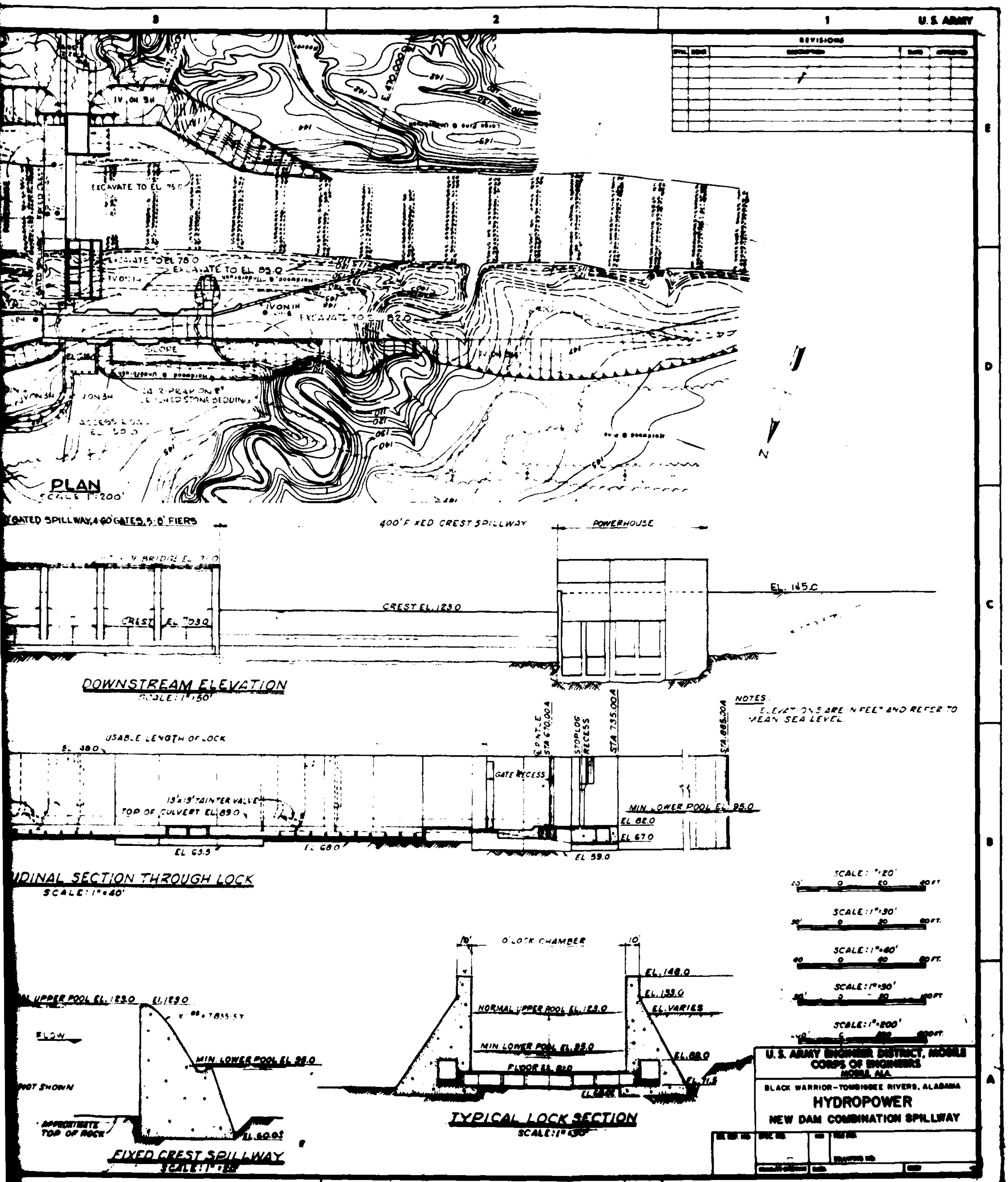
LONGITUDINAL SECTION THROUGH LOC[K]
SCALE: 1"=40'



SPILLWAY SECTION
SCALE: 1"=20'



FIXED CREST SPIL[LWAY]
SCALE: 1"=


U.S. ARMY
REVISIONS
PLAN
SCALE 1":200'
EXCAVATE TO EL 75.0
EXCAVATE TO EL 78.0
EXCAVATE TO EL 85.0
EXCAVATE TO EL 82.0
1V ON 3H
1V ON 1H
SLOPE
ACCESS ROAD EL 59.0
N
GATED SPILLWAY, 4-60' GATES, 5-8' PIERS
400' FIXED CREST SPILLWAY
POWERHOUSE
CREST EL 123.0
CREST EL 103.0
EL 145.0
DOWNSTREAM ELEVATION
SCALE: 1"=50'
NOTES
ELEVATIONS ARE IN FEET AND REFER TO MEAN SEA LEVEL.
USABLE LENGTH OF LOCK
EL 48.0
GATE RECESS
STOPLOG RECESS
STA 670.00A
STA 735.00A
STA 885.00A
15'x15' TAINTER VALVE
TOP OF CULVERT EL 89.0
MIN. LOWER POOL EL 95.0
EL 82.0
EL 67.0
EL 59.0
EL 63.5
EL 68.0
LONGITUDINAL SECTION THROUGH LOCK
SCALE: 1"=40'
SCALE: 1"=20'
SCALE: 1"=30'
SCALE: 1"=40'
SCALE: 1"=50'
SCALE: 1"=200'
NORMAL UPPER POOL EL 123.0
EL 123.0
FLOW
MIN. LOWER POOL EL 95.0
NOT SHOWN
APPROXIMATE TOP OF ROCK
EL 60.0
FIXED CREST SPILLWAY
EL 148.0
EL 133.0
EL VARIES
NORMAL UPPER POOL EL 123.0
MIN. LOWER POOL EL 95.0
FLOOR EL 81.0
EL 88.0
EL 71.5
TYPICAL LOCK SECTION
SCALE: 1"=30'
U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.
BLACK WARRIOR-TOMBIGBEE RIVERS, ALABAMA
HYDROPOWER
NEW DAM COMBINATION SPILLWAY

APPENDIX A

SECTION IV

DETAILED COST ESTIMATES

Detailed estimates for the lock and dam Alternatives Numbers 1 thru 4 are included in this section. They are based on October 1982 prices and quantity estimates made by the Engineering Division of the Mobile District.

Estimates for three power plants were obtained from the publication "Feasibility Studies for Small Scale Hydropower Additions" are are summarized in this section. These plants were considered with the navigation alternatives and range in size from 10.1 to 16.3 megawatts.

Real estate estimates based on October 1982 prices are shown at the end of the section.

<u>COST SUMMARY ($1,000)</u>
(Structural)

Alternative #1

Existing Dam with 110 x 600 foot Lock in Left Decending Bank

Relocations	$ 33,800
Lands and Damages	3,700
Dam	
Spillway	-
Spillway Channel	-
Lock	58,200
Channels	
Lock Approaches	18,200
Spillway Removal	-
Access Roads	300
Cultural Resources	100
Buildings Grounds & Utilities	300
SUBTOTAL	$114,600
Engineering and Design	8,000
Supervision and Administration	6,300
TOTAL	$128,900

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

Alternative No. 1

SUBJECT: BLACK WARRIOR

PROJECT: OLIVER REPLACEMENT LOCK AND DAM
LEFT BANK (600' X 110')

LOCATION:

MAY 83

COMPUTED: REW **CHECKED:** **DATE:** OCT 82 PRICE LEVEL

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
02	RELOCATIONS:				
	GM & O RAILROAD BRIDGE		JOB		30,254,000
	SPUR		JOB		2,167,000
	CONTINGENCIES AT 20%				1,410,000
	TOTAL FOR RELOCATIONS				33,831,000

MOB FORM 67
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U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

Alternative No. 1

SUBJECT: BLACK WARRIOR

PROJECT: OLIVER REPLACEMENT LOCK & DAM
LEFT BANK (600' X 110')

LOCATION: TUSCALOOSA

COMPUTED: REW **CHECKED:** **DATE:** MAY 83
OCT 82 PRICE LEVEL

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
5	LOCK				
	COFFERDAM AND PUMPING		JOB		1,563,000
	CLEARING	26	ACRE	2,130.00	55,000
	EXCAVATION, COMMON	1,316,900	C.Y.	3.20	4,214,000
	EXCAVATION, ROCK	310,200	C.Y.	7.50	2,327,000
	BACKFILL COMPACTED FROM EXCAVATION	256,000	C.Y.	1.85	474,000
	CONCRETE	240,190	C.Y.	111.00	26,661,000
	STEEL REINFORCEMENT	735	TON	1,226.00	901,000
	HANDRAILING	6,000	L.F.	53.00	318,000
	MISCELLANEOUS METAL	40	TON	5,275.00	211,000
	GRATING	67	TON	5,550.00	372,000
	WALL ARMOR	250	TON	3,600.00	900,000
	UPPER MITER GATE, COMPLETE	300	TON	5,500.00	1,650,000
	LOWER MITER GATE, COMPLETE	460	TON	5,200.00	2,392,000
	MITER GATE MACHINERY	4	EACH	263,000.00	1,052,000
	TAINTER VALVES, COMPLETE	140	TON	5,650.00	791,000
	TAINTER VALVE MACHINERY	4	EACH	133,000.00	532,000
	HYDRAULIC SYSTEM		JOB		698,000
	COMPRESSED AIR AND WATER SYSTEM				437,000
	CULVERT BULKHEADS, COMPLETE	48	TON	4,850.00	233,000
	FLOATING MOORING BITTS, COMPLETE	47	TON	5,650.00	266,000

MOB FORM 67
Revised 24 Jun

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

Alternative No. 1

SUBJECT: BLACK WARRIOR

PROJECT: OLIVER REPLACEMENT LOCK & DAM
LEFT BANK (600' X 110')

LOCATION: TUSCALOOSA

COMPUTED: REW

CHECKED:

DATE: MAY 83
OCT 82 PRICE LEVEL

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
5	LOCK (CONT'D)				
	ELECTRICAL SYSTEM		JOB		1,421,000
	CONTROL STATION, COMPLETE		JOB		400,000
	ENGINE GENERATOR		JOB		71,000
	INSTRUMENTATION		JOB		531,000
	CONTINGENCIES AT 20%				9,694,000
	TOTAL FOR LOCK				58,164,000

MOD FORM 67
Revised 24 June 6

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

Alternative No. 1

SUBJECT: BLACK WARRIOR

PROJECT: OLIVER REPLACEMENT LOCK & DAM
LEFT BANK (600' X 110')

LOCATION: TUSCALOOSA

COMPUTED: REW

CHECKED:

DATE: MAY 83
OCT 82 PRICE LEVEL

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
8	ACCESS ROADS:				
	ACCESS ROADS		JOB		263,000
	CONTINGENCIES AT 20%				53,000
	TOTAL FOR ACCESS ROADS				316,000
9	CHANNEL-LOCK APPROACHES				
	CLEARING	78	ACRE	2,130.00	166,000
	EXCAVATION, COMMON	3,697,100	C.Y.	3.20	11,831,000
	EXCAVATION, ROCK	290,400	C.Y.	7.50	2,178,000
	RIPRAP	22,910	C.Y.	32.00	733,000
	FILTER MATERIAL	8,590	C.Y.	26.50	228,000
	CONTINGENCIES AT 20%				3,027,000
	TOTAL FOR CHANNELS				18,163,000
	TOTAL				110,474,000

MOB FORM 67
Revised 24 June 6C

COST SUMMARY ($1,000)
(Structural)

Alternative #2

New 110 x 600 foot Lock 2,700 feet Downstream with Fixed Crest Spillway

Relocations	-
Lands and Damages	$ 2,100
Dam	
Spillway	16,100
Spillway Channel	4,600
Lock	56,600
Channels	
Lock Approaches	13,000
Spillway Removal	100
Access Roads	200
Cultural Resources	100
Buildings Grounds & Utilities	300
SUBTOTAL	$ 93,100
Engineering and Design	6,500
Supervision and Administration	5,100
TOTAL	$104,700

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

Alternative No. 2

SUBJECT: BLACK WARRIOR

PROJECT: OLIVER REPLACEMENT LOCK & DAM
RIGHT BANK (600' X 110') FIXED CREST SPILLWAY

LOCATION: TUSCALOOSA

COMPUTED: REW **CHECKED:** **DATE:** MAY 83
OCT 82 PRICE LEVEL

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
04	DAM				
	SPILLWAY:				
	COFFERDAM AND PUMPING		JOB		6,922,000
	CLEARING	5	ACRE	2,130.00	11,000
	EXCAVATION, COMMON	60,200	C.Y.	3.20	193,000
	EXCAVATION, ROCK	11,800	C.Y.	7.50	89,000
	BACKFILL, COMPACTED (STOCKPILED FROM REQUIRED EXCAVATION)	62,800	C.Y.	3.20	201,000
	RIPRAP	1,130	C.Y.	32.00	36,000
	FILTER MATERIAL	420	C.Y.	26.50	11,000
	CONCRETE, SILLS	41,320	C.Y.	98.00	4,049,000
	CONCRETE, PIERS	-	C.Y.	-	-
	CONCRETE, ABUTMENT WALLS	15,750	C.Y.	98.00	1,544,000
	CONCRETE, STILLING BASIN	-	C.Y.	-	-
	STEEL REINFORCEMENT	-	TON	-	-
	PEDESTRIAN SPILLWAY BRIDGE	-	L.F.	-	-
	TAINTER GATES, COMPLETE	-	EACH	-	-
	TAINTER GATES MACHINERY	-	EACH	-	-
	ELECTRICAL SYSTEM	-	JOB	-	-
	INSTRUMENTATION		JOB		373,000
	CONTINGENCIES AT 20%				2,686,000
	SUBTOTAL FOR SPILLWAY				16,115,000

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U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

Alternative No. 2

SUBJECT: BLACK WARRIOR

PROJECT: OLIVER REPLACEMENT LOCK & DAM
RIGHT BANK (600' X 110') FIXED CREST SPILLWAY

LOCATION: TUSCALOOSA

COMPUTED: REW **CHECKED:** **DATE:** MAY 83
OCT 82 PRICE LEVEL

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
04	DAM (CONT'D)				
	SPILLWAY CHANNEL:				
	CLEARING	19	ACRE	2,130.00	40,000
	EXCAVATION, COMMON	935,200	C.Y.	3.20	2,993,000
	EXCAVATION, ROCK	6,500	C.Y.	7.50	49,000
	RIPRAP	17,560	C.Y.	32.00	562,000
	FILTER MATERIAL	6,580	C.Y.	26.50	174,000
	CONTINGENCIES AT 20%				764,000
	SUBTOTAL FOR SPILLWAY CHANNEL				4,582,000
	TOTAL FOR DAM				20,697,000

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U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

Alternative No. 2

SUBJECT: BLACK WARRIOR

PROJECT: OLIVER REPLACEMENT LOCK & DAM
RIGHT BANK (110' X 600') FIXED CREST SPILLWAY **LOCATION:** TUSCALOOSA

COMPUTED: REW **CHECKED:** **DATE:** MAY 83
OCT 82 PRICE LEVEL

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
5	LOCK				
	COFFERDAM AND PUMPING		JOB		6,922,000
	CLEARING	34	ACRE	2,130.00	72,000
	EXCAVATION, COMMON	478,500	C.Y.	3.20	1,531,000
	EXCAVATION, ROCK	152,500	C.Y.	7.50	1,144,000
	BACKFILL COMPACTED FROM EXCAVATION	128,000	C.Y.	1.85	237,000
	CONCRETE	217,590	C.Y.	111.00	24,152,000
	STEEL REINFORCEMENT	670	TON	1,226.00	821,000
	HANDRAILING	6,000	L.F.	53.00	318,000
	MISCELLANEOUS METAL	40	TON	5,275.00	211,000
	GRATING	67	TON	5,550.00	372,000
	WALL ARMOR	250	TON	3,600.00	900,000
	UPPER MITER GATE, COMPLETE	300	TON	5,500.00	1,650,000
	LOWER MITER GATE, COMPLETE	460	TON	5,200.00	2,392,000
	MITER GATE MACHINERY	4	EACH	263,000.00	1,052,000
	TAINTER VALVES, COMPLETE	140	TON	5,650.00	791,000
	TAINTER VALVE MACHINERY	4	EACH	133,000.00	532,000
	HYDRAULIC SYSTEM		JOB		698,000
	COMPRESSED AIR AND WATER SYSTEM				437,000
	CULVERT BULKHEADS, COMPLETE	48	TON	4,850.00	233,000
	FLOATING MOORING BITTS, COMPLETE	47	TON	5,650.00	266,000

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U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

Alternative No. 2

SUBJECT: BLACK WARRIOR

PROJECT: OLIVER REPLACEMENT LOCK & DAM RIGHT BANK (110' X 600') FIXED CREST SPILLWAY   LOCATION: TUSCALOOSA

COMPUTED: REW   CHECKED: DATE: MAY 83
OCT 82 PRICE LEVEL

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
5	LOCK (CONT'D)				
	ELECTRICAL SYSTEM		JOB		1,421,000
	CONTROL STATION, COMPLETE		JOB		400,000
	ENGINE GENERATOR		JOB		71,000
	INSTRUMENTATION		JOB		531,000
	CONTINGENCIES AT 20%				9,431,000
	TOTAL FOR LOCK				56,585,000

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U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

Alternative No. 2

SUBJECT: BLACK WARRIOR

PROJECT: OLIVER REPLACEMENT LOCK & DAM
RIGHT BANK (110' X 600') FIXED CREST SPILLWAY

LOCATION: TUSCALOOSA

COMPUTED: REW **CHECKED:** **DATE:** MAY 83
OCT 82 PRICE LEVEL

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
8	ACCESS ROADS:				
	ACCESS ROADS		JOB		172,000
	CONTINGENCIES AT 20%				34,000
	TOTAL FOR ACCESS ROADS				206,000
9	CHANNEL-LOCK APPROACHES				
	CLEARING	55	ACRE	2,130.00	117,000
	EXCAVATION, COMMON	2,701,600	C.Y.	3.20	8,645,000
	EXCAVATION, ROCK	151,700	C.Y.	7.50	1,138,000
	RIPRAP	22,910	C.Y.	32.00	733,000
	FILTER MATERIAL	8,590	C.Y.	26.50	228,000
	CONTINGENCIES AT 20%				2,172,000
	TOTAL FOR CHANNELS				13,033,000
	TOTAL				90,521,000

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COST SUMMARY ($1,000)
(Structural)

Alternative #3

New 110 x 600 foot Lock at Existing Site with Gated Spillway

Relocations	-
Lands and Damages	$ 1,500
Dams	
Spillway	35,800
Spillway Channel	14,300
Lock	66,400
Channels	
Lock Approaches	-
Spillway Removal	-
Access Roads	300
Cultural Resources	100
Buildings Grounds & Utilities	300
SUBTOTAL	$ 118,700
Engineering and Design	8,300
Supervision and Administration	6,500
TOTAL	$ 133,500

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

Alternative #3

SUBJECT: OLIVER REPLACEMENT LOCK & DAM
(LOCK IN RIVER)

PROJECT:

LOCATION:

COMPUTED: LJC

CHECKED:

DATE: DEC 82
OCT 82 PRICE LEVEL

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
	FIRST STAGE				
1.	FURNISHING & INSTALLING S-28 PILING	3,472	TONS	960.00	3,333,000
2.	CELL FILL	137,400	C.Y.	4.10	563,000
3.	BERM FILL	13,335	C.Y.	4.10	55,000
4.	DEWATERING	1	JOB		533,000
5.	CONCRETE REMOVAL	36,850	C.Y.	26.50	977,000
6.	PULLING PILES	3,090	TON	150.00	464,000
7.	REMOVING CELL FILL	121,710	C.Y.	3.50	426,000
8.	REMOVE BERM FILL	13,335	C.Y.	3.50	47,000
					6,398,000
	CONTINGENCY @ 20%				1,280,000
	TOTAL FIRST STAGE				7,678,000

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U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

Alternative #3

SUBJECT: OLIVER REPLACEMENT LOCK & DAM
(LOCK IN RIVER)

PROJECT:

LOCATION:

COMPUTED: LJC

CHECKED:

DATE: DEC 82
OCT 82 PRICE LEVEL

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
	SECOND STAGE				
1.	FURNISHING & INSTALLING S-28 PILING	7,824	TON	960.00	7,511,000
2.	INSTALLING S-28 PILES	3,090	TON	277.00	856,000
3.	CELL FILL	434,778	C.Y.	4.10	1,783,000
4.	DEWATERING	1	JOB		800,000
5.	CONCRETE REMOVAL	13,161	C.Y.	26.50	349,000
6.	PULLING PILES	10,026	TON	150.00	1,504,000
7.	REMOVING CELL FILL	414,851	C.Y.	3.50	1,452,000
8.	CONSTR. & REMOVE BRIDGE	1	JOB		426,000
					14,681,000
	CONTINGENCY @ 20%				2,936,000
	TOTAL SECOND STAGE				17,617,000

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U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

Alternative #3

SUBJECT: OLIVER REPLACEMENT L & D (LOCK IN RIVER)

PROJECT:

LOCATION:

COMPUTED: LJC

CHECKED:

DATE: DEC 82
OCT 82 PRICE LEVEL

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
	THIRD STAGE				
1.	INSTALLING S-28 PILES	3,847	TON	277.00	1,066,000
2.	CELL FILL	151,570	C.Y.	4.10	621,000
3.	BERM FILL	3,300	C.Y.	4.10	14,000
4.	DEWATERING	1	JOB		373,000
5.	CONCRETE REMOVAL	45,760	C.Y.	26.50	1,213,000
6.	PULLING PILES	4,735	TON	150.00	710,000
7.	REMOVING CELL FILL	187,187	C.Y.	3.50	655,000
8.	REMOVING BERM FILL	3,300	C.Y.	3.50	12,000
					4,664,000
	CONTINGENCY @ 20%				933,000
	TOTAL THIRD STAGE				5,597,000

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U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

Alternative #3

SUBJECT: OLIVER REPLACEMENT L & D
(LOCK IN RIVER)

PROJECT:

LOCATION: OCT 82
PRICE LEVELS

COMPUTED: LJC **CHECKED:** **DATE:** DEC 82

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
04	DAM				
	SPILLWAY:				
	CONCRETE NON-OVERFLOW	10,970	C.Y.	106.00	1,163,000
	FILL	55,000	C.Y.	3.20	176,000
	CONCRETE TRAINING WALLS	670	C.Y.	128.00	86,000
	EXCAVATION, ROCK	87,080	C.Y.	7.50	653,000
	BACKFILL, COMPACTED (STOCKPILED FROM REQUIRED EXCAVATION)	3,200	C.Y.	3.20	10,000
	RIPRAP	141,200	C.Y.	32.00	4,518,000
	FILTER MATERIAL	35,300	C.Y.	26.50	935,000
	CONCRETE, SILLS	47,460	C.Y.	98.00	4,651,000
	CONCRETE, PIERS	8,210	C.Y.	195.00	1,601,00
	CONCRETE, ABUTMENT WALLS	5,850	C.Y.	98.00	573,000
	CONCRETE, STILLING BASIN	5,680	C.Y.	128.00	727,000
	STEEL REINFORCEMENT	468	TON	1,226.00	574,000
	PEDESTRIAN SPILLWAY BRIDGE	476	L.F.	501.00	238,000
	TAINTER GATES, COMPLETE	7	EACH	454,000.00	3,178,000
	TAINTER GATES MACHINERY	7	EACH	266,500.00	1,866,000
	ELECTRICAL SYSTEM	1	JOB		587,000
	INSTRUMENTATION	1	JOB		373,000
	CONTINGENCIES AT 20%				4,382,000
	SUBTOTAL FOR SPILLWAY				26,292,000

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U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

Alternative #3

SUBJECT: OLIVER L & D REPLACEMENT
(LOCK IN RIVER)

PROJECT:

LOCATION:

COMPUTED: LJC

CHECKED:

DATE: DEC 82
OCT 82 PRICE LEVEL

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
04	DAM (CONT'D)				
	SPILLWAY CHANNEL:				
	CLEARING	5	ACRE	2,130.00	11,000
	EXCAVATION, COMMON	2,118,600	C.Y.	3.20	6,780,000
	EXCAVATION, ROCK	266,700	C.Y.	7.50	2,000,000
	RIPRAP		C.Y.		
	FILTER MATERIAL		C.Y.		
	CONTINGENCIES AT 20%				1,758,000
	SUBTOTAL FOR SPILLWAY CHANNEL				10,549,000
	TOTAL FOR DAM				36,841,000

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U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

Alternative #3

SUBJECT: OLIVER REPLACEMENT L & D
(LOCK IN RIVER)

PROJECT:

LOCATION: OCT 82 PRICE LEVELS

COMPUTED: LJC CHECKED: DATE: DEC 82

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
5	LOCK				
	COFFERDAM AND PUMPING		JOB		
	CLEARING		ACRE		
	EXCAVATION, COMMON		C.Y.		
	EXCAVATION, ROCK	277,800	C.Y.	7.50	2,084,000
	BACKFILL COMPACTED FROM EXCAVATION		C.Y.		
	CONCRETE	217,590	C.Y.	117.00	25,458,000
	STEEL REINFORCEMENT	670	TON	1,280.00	858,000
	HANDRAILING	6,000	L.F.	53.00	318,000
	MISCELLANEOUS METAL	40	TON	5,275.00	211,000
	GRATING	67	TON	5,550.00	372,000
	WALL ARMOR	250	TON	3,600.00	900,000
	UPPER MITER GATE, COMPLETE	300	TON	5,500.00	1,650,000
	LOWER MITER GATE, COMPLETE	460	TON	5,200.00	2,392,000
	MITER GATE MACHINERY	4	EACH	263,000.00	1,052,000
	TAINTER VALVES, COMPLETE	140	TON	5,650.00	791,000
	TAINTER VALVE MACHINERY	4	EACH	133,000.00	532,000
	HYDRAULIC SYSTEM	1	JOB		698,000
	COMPRESSED AIR AND WATER SYSTEM	1			437,000
	CULVERT BULKHEADS, COMPLETE	48	TON	4,850.00	233,000
	FLOATING MOORING BITTS, COMPLETE	47	TON	5,650.00	266,000

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U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

Alternative #3

SUBJECT: OLIVER REPLACEMENT L & C
(LOCK IN RIVER)

PROJECT:

LOCATION: OCT 82 PRICE LEVELS

COMPUTED: LJC

CHECKED:

DATE: DEC 82

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
5	LOCK (CONT'D)				
	ELECTRICAL SYSTEM	1	JOB		1,421,000
	CONTROL STATION, COMPLETE	1	JOB		400,000
	ENGINE GENERATOR	1	JOB		71,000
	INSTRUMENTATION	1	JOB		531,000
	CONTINGENCIES AT 20%				8,135,000
	TOTAL FOR LOCK				48,810,000
	TOTAL				116,543,000

SAD FORM (Revised 24 Ju

COST SUMMARY ($1,000)
(Structural)

Alternative #4

New 110 x 600 foot Lock at Existing Site with Both Gated and Fixed Crest Spillways

Relocations	-
Lands and Damages	$ 1,500
Dam	
Spillway	16,200
Spillway Channel	11,600
Lock	67,600
Channels	
Lock Approaches	-
Spillway Removal	-
Access Roads	300
Cultural Resources	100
Building Grounds & Utilities	300
SUBTOTAL	$97,600
Engineering and Design	6,800
Supervision and Administration	5,400
TOTAL	$109,800

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

Alternative No. 4

SUBJECT: OLIVER REPLACEMENT L & D 4 GATES SPILLWAY
(LOCK IN RIVER - GATED SPILLWAY ON LEFT)

PROJECT:

LOCATION: OCT 1981 PRICE LEVEL

COMPUTED: LJC **CHECKED:** **DATE:** DEC 82
OCT 82 PRICE LEVEL

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
	FIRST STAGE				
1.	FURNISHING & INSTALLING	11,042	TON	960.00	10,600,000
	S-28 PILING				
2.	CLLL FILL	436,268	C.Y.	4.10	1,789,000
3.	DEWATERING	1	JOB		533,000
4.	CONCRETE REMOVAL	13,200	C.Y.	26.50	350,000
5.	PULLING PILES	10,155	TON	150.00	1,523,000
6.	REMOVING CELL FILL	400,651	C.Y.	3.50	1,402,000
7.	CONSTRUCTION BRIDGE	1	JOB		426,000
	INSTALLATION & REMOVAL				
	SUBTOTAL 1ST STAGE				16,623,000
	CONTINGENCIES @ 20%				3,325,000
	TOTAL - FIRST STAGE				19,948,000

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U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

Alternative No. 4

SUBJECT: OLIVER REPLACEMENT L & D
(LOCK IN RIVER - GATED SPILLWAY ON LEFT)

PROJECT: LOCATION:

COMPUTED: LJC CHECKED: DATE: DEC 82
OCT 82 PRICE LEVEL

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
	SECOND STAGE				
1.	INSTALLING S-28 PILING	2,394	TON	277.00	663,000
2.	CELL FILL	93,907	C.Y.	4.10	385,000
3.	BERM FILL	13,335	C.Y.	4.10	55,000
4.	DEWATERING	1	JOB		533,000
5.	CONCRETE REMOVAL	90,000	C.Y.	26.50	2,385,000
6.	PULLING PILES	3,280	TON	150.00	492,000
7.	REMOVING CELL & BERM FILL	107,242	C.Y.	3.50	375,000
	SUBTOTAL SECOND STAGE				4,888,000
	CONTINGENCIES @ 20%				978,000
	TOTAL SECOND STAGE				5,866,000

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U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

Alternative No. 4

SUBJECT: OLIVER REPLACEMENT L & D

PROJECT: LOCATION:

COMPUTED: LJC CHECKED: DATE: DEC 82
OCT 82 PRICE LEVEL

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
	THIRD STAGE				
1.	INSTALLING S-28 PILING	1,706	TON	277.00	473,000
2.	CELL FILL	67,625	C.Y.	4.10	277,000
3.	BERM FILL	13,335	C.Y.	4.10	55,000
4.	DEWATERING		JOB		426,000
5.	PULLING PILES	1,706	TON	150.00	256,000
6.	REMOVING CELL & BERM FILL	80,960	C.Y.	3.50	283,000
	SUBTOTAL THIRD STAGE				1,770,000
	CONTINGENCIES @ 20%				354,000
	TOTAL THIRD STAGE				2,124,000

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U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

Alternative No. 4

SUBJECT: OLIVER REPLACEMENT L & D
(LOCK IN RIVER W/ GATED SPILLWAY ON LEFT)

PROJECT:

LOCATION: OCT 82 PRICE LEVEL

COMPUTED: LJC **CHECKED:** **DATE:** DEC 82

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
04	DAM				
	SPILLWAY:				
	FILL	31,000	C.Y.	3.20	99,000
	CONCRETE, TRAINING WALLS	670	C.Y.	128.00	86,000
	EXCAVATION, COMMON	66,700	C.Y.	3.20	213,000
	EXCAVATION, ROCK	59,300	C.Y.	7.50	445,000
	BACKFILL, COMPACTED (STOCKPILED FROM REQUIRED EXCAVATION)	20,000	C.Y.	3.20	64,000
	RIPRAP	5,000	C.Y.	32.00	160,000
	FILTER MATERIAL	1,250	C.Y.	26.50	33,000
	CONCRETE, SILLS	27,100	C.Y.	98.00	2,656,000
	CONCRETE, PIERS	4,690	C.Y.	195.00	915,000
	CONCRETE, ABUTMENT WALLS	5,850	C.Y.	98.00	573,000
	CONCRETE, STILLING BASIN	3,240	C.Y.	128.00	415,000
	STEEL REINFORCEMENT	267	TON	1,226.00	327,000
	PEDESTRIAN SPILLWAY BRIDGE	272	L.F.	501.00	136,000
	TAINTER GATES, COMPLETE	4	EACH	454,000.00	1,816,000
	TAINTER GATES MACHINERY	4	EACH	266,500.00	1,066,000
	ELECTRICAL SYSTEM	1	JOB		335,500
	INSTRUMENTATION	1	JOB		213,000
	CONTINGENCIES AT 20%				1,911,000
	TOTAL				11,464,000

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U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

Alternative No. 4

SUBJECT:

PROJECT: LOCATION:

COMPUTED: CHECKED: DATE: OCT 82 PRICE LEVEL

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
04	DAM (CONT'D)				
	SPILLWAY CHANNEL:				
	CLEARING	5	ACRE	2,130.00	11,000
	EXCAVATION, COMMON	939,800	C.Y.	3.20	3,007,000
	EXCAVATION, ROCK		C.Y.		
	RIPRAP	120,000	C.Y.	32.00	3,840,000
	FILTER MATERIAL		C.Y.		
	CONTINGENCIES AT 20%				1,372,000
	SUBTOTAL FOR SPILLWAY CHANNEL				8,230,000
	TOTAL FOR DAM				19,694,000

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Alternative #4

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

SUBJECT: OLIVER REPLACEMENT L & D
(LOCK IN RIVER)

PROJECT:

LOCATION: OCT 82 PRICE LEVELS

COMPUTED: LJC **CHECKED:** **DATE:** Dec 82

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
5	LOCK				
	COFFERDAM AND PUMPING		JOB		
	CLEARING		ACRE		
	EXCAVATION, COMMON		C.Y.		
	EXCAVATION, ROCK	277,800	C.Y.	7.50	2,084,000
	BACKFILL COMPACTED FROM EXCAVATION		C.Y.		
	CONCRETE	217,590	C.Y.	117.00	25,458,000
	STEEL REINFORCEMENT	670	TON	1,280.00	858,000
	HANDRAILING	6,000	L.F.	53.00	318,000
	MISCELLANEOUS METAL	40	TON	5,275.00	211,000
	GRATING	67	TON	5,550.00	372,000
	WALL ARMOR	250	TON	3,600.00	900,000
	UPPER MITER GATE, COMPLETE	300	TON	5,500.00	1,650,000
	LOWER MITER GATE, COMPLETE	460	TON	5,200.00	2,392,000
	MITER GATE MACHINERY	4	EACH	263,000.00	1,052,000
	TAINTER VALVES, COMPLETE	140	TON	5,650.00	791,000
	TAINTER VALVE MACHINERY	4	EACH	133,000.00	532,000
	HYDRAULIC SYSTEM	1	JOB		698,000
	COMPRESSED AIR AND WATER SYSTEM	1			437,000
	CULVERT BULKHEADS, COMPLETE	48	TON	4,850.00	233,000
	FLOATING MOORING BITTS, COMPLETE	47	TON	5,650.00	266,000

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
Office of the District Engineer
ENGINEERING DIVISION

Alternative #4

SUBJECT: OLIVER REPLACEMENT L & C
(LOCK IN RIVER)

PROJECT:

LOCATION: OCT 82
PRICE LEVELS

COMPUTED: LJC **CHECKED:** **DATE:** DEC 82

ITEM NO.	DESCRIPTION OF WORK	ESTIMATED QUANTITY	UNIT	UNIT COST	TOTAL COST
5	LOCK (CONT'D)				
	ELECTRICAL SYSTEM	1	JOB		1,421,000
	CONTROL STATION, COMPLETE	1	JOB		400,000
	ENGINE GENERATOR	1	JOB		71,000
	INSTRUMENTATION	1	JOB		531,000
	CONTINGENCIES AT 20%				8,135,000
	LESS DIFFERENCE IN GUIDE WALLS				
	(CELLS VS CONCRETE WALLS)				-957,000
	TOTAL FOR LOCK				47,853,000
	TOTAL				95,485,000

MOB FORM 6
Revised 24 Ju

COST ESTIMATE SHEET

PROJECT Oliver Lock PLANT CAP. 10.11 MW DATE 25 May 1983

JOB NO. ANN ENERGY 30,560 MKWH BY Lloyd

ACCOUNT NO.	DESCRIPTION	QUANTITY	UNIT COST	COSTS JULY 1978	Escalation Factor	COSTS DATE
333	WATER WHEELS, TURBINES AND GENERATORS TURB. TYPE GEN. TYPE RATING 10.11 MW 21.5 FT. D_2 FT. INSTALLAED COST (FIG 3-12 TO 3-16)	1		$4,400,000	1.49	$6,560,C00 (Oct 82)
334	STATION ELECTRICAL EQUIPMENT TRANSFORMER, LIGHTING ARRESTOR, AIR BREAKER SWT. GEN. BREAKER AND LINE OCB (FIG. 6-3)......................			280,000	1.41	390,000
	BATTERY SYS., STA. SWT GEAR, STA. SER. TRANS.,BUS,CABLE CONDUIT, GRD., CONTROL BD., LIGHTING SYS., FREIGHT AND INSTALLATION (FIG. 5-4).............................			480,000	1.41	680,000
335	MISC. POWER PLANT EQUIPMENT VENTILATION, FIRE PROTECTION, COOLING WATER, COMMUNICATION SYS., FREIGHT AND INSTALLATION (FIG. 6-5)...			110,000	1.38	150,000
350	TRANSMISSION LINE LENGTH MI VOLT. KV (FIG. 6-4).............					

COST PER INSTALLED KW		SUB TOTAL	$7,780,000
	CONTINGENCY (25%)		1,950,000
		SUB TOTAL	9.730,000
	ENGINEERING, CONSTR. MG. & OTHER COSTS (20%)		1,950,000
	TOTAL INSTALLED COST		11,680,000

FERC Acct. No.	Description 10.1 MW	Cost* ($1,000)	Escalation Factor (Oct 82)	Escalated Cost ($1,000)	Total ($1,000)
332	RESERVOIRS, DAMS & WATERWAYS				
.01	Penstock	90	1.38	124	
.02	Valves	260		359	
.03	Bifurcation & Slide Gates	40		55	
.04	Tailrace	41		57	
.05					
.06					
	Total, Account 332				595
	TOTAL CIVIL COSTS				2,364
	Contingencies (25%)				591
	Regional Correction Factor				(.85)
	CORRECTED CIVIL COSTS				2,511
	Engineering, Construction Management and Other Costs (20%)				502
	GRAND TOTAL				3,013
	* Cost Base, July 1978				

EXHIBIT I
COST SUMMARY SHEET

PROJECT Oliver Lock
JOB NO. ______
DATE 27 May 83

PLANT CAPACITY 10.1 MW
AVG. ANNUAL ENERGY 30,560 MWh
BY Meader

FERC ACCT. NO.	DESCRIPTION	COST* ($1,000)	ESCALATION FACTOR (Oct 82)	ESCALATED COST ($1,000)	TOTAL ($1,000)
331	STRUCTURES & IMPROVEMENTS				
	SITE				
.11	DRAINAGE SYSTEM	2	1.38	3	
.12	EROSION CONTROL	4		6	
.13	FINAL GRADING	7		10	
.14	ACCESS ROAD	25		35	
.15	PARKING & MISC. SITE FEATURES	48		67	
.16	ENVIRONMENTAL CONSTRUCTION CONTROLS	10		14	
.17					
.18					
	POWERHOUSE				
.21	STRUCTURAL	1,000	1.38	1,380	
.22	EXCAVATION	54		75	
.23	FOUNDATION	100		138	
.24	SWITCHYARD	30		41	
.25					
.26					
	TOTAL, ACCOUNT 331				1,769
	* COST BASE JULY 1978				

COST ESTIMATE SHEET

PROJECT Oliver Lock PLANT CAP. 13.2 MW DATE 27 May 1983

JOB NO. ANN ENERGY 39,400 MKWH BY Lloyd

ACCOUNT NO.	DESCRIPTION	QUANTITY	UNIT COST	COSTS JULY 1978	Escalation Factor	COSTS DATE
333	WATER WHEELS, TURBINES AND GENERATORS TURB. TYPE GEN. TYPE RATING 13.2 MW 21.5 FT. D_2 FT. INSTALLAED COST (FIG 3-12 TO 3-16)	1		$4,900,000	1.49	$7,300,000 (Oct 82)
334	STATION ELECTRICAL EQUIPMENT TRANSFORMER, LIGHTING ARRESTOR, AIR BREAKER SWT, GEN. BREAKER AND LINE OCB (FIG. 6-3)......................			310,000	1.41	440,000
	BATTERY SYS., STA. SWT GEAR, STA. SER. TRANS.,BUS,CABLE CONDUIT, GRD., CONTROL BD., LIGHTING SYS., FREIGHT AND INSTALLATION (FIG. 5-4)............................			560,000	1.41	790,000
335	MISC. POWER PLANT EQUIPMENT VENTILATION, FIRE PROTECTION, COOLING WATER, COMMUNICATION SYS., FREIGHT AND INSTALLATION (FIG. 6-5)..			140,000	1.38	190,000
350	TRANSMISSION LINE LENGTH MI VOLT. KV (FIG. 6-4)..					
COST PER INSTALLED KW				SUB TOTAL		$8,720,000
	CONTINGENCY (25 %)					2,180,000
				SUB TOTAL		10,900,000
	ENGINEERING, CONSTR. MG. & OTHER COSTS (20%)					2,180,000
	TOTAL INSTALLED COST					13,080,000

EXHIBIT I
COST SUMMARY SHEET

PROJECT Oliver Lock
JOB NO. ____
DATE 27 May 83

PLANT CAPACITY 13.2 MW
AVG. ANNUAL ENERGY 39,400 MWh
BY Meader

FERC ACCT. NO.	DESCRIPTION	COST* ($1,000)	ESCALATION FACTOR (Oct 82)	ESCALATED COST ($1,000)	TOTAL ($1,000)
331	STRUCTURES & IMPROVEMENTS				
	SITE				
.11	DRAINAGE SYSTEM	2	1.38	3	
.12	EROSION CONTROL	4		6	
.13	FINAL GRACING	7		10	
.14	ACCESS ROAD	25		35	
.15	PARKING & MISC. SITE FEATURES	48		67	
.16	ENVIRONMENTAL CONSTRUCTION CONTROLS	10		14	
.17					
.18					
	POWERHOUSE	1,000	1.38	1,380	
.21	STRUCTURAL	54		75	
.22	EXCAVATION	100		138	
.23	FOUNDATION	38		52	
.24	SWITCHYARD				
.25					
.26					
	TOTAL, ACCOUNT 331				1,780

* COST BASE JULY 1978

FERC Acct. No.	Description 13.2 MW	Cost* ($1,000)	Escalation Factor (Oct 82)	Escalated Cost ($1,000)	Total ($1,000)
332	RESERVOIRS, DAMS & WATERWAYS				
.01	PENSTOCK	90	1.38	124	
.02	VALVES	260		359	
.03	BIFURCATION & SLIDE GATES	40		55	
.04	TAILRACE	41		57	
.05					
.06					
	TOTAL, ACCOUNT 332				595
	TOTAL CIVIL COSTS				2,375
	CONTINGENCIES (25%)				593
	REGIONAL CORRECTION FACTOR				(.85)
	CORRECTED CIVIL COSTS				2,522
	ENGINEERING, CONSTRUCTION MANAGEMENT AND OTHER COSTS (20%)				504
	GRAND TOTAL				3,026
	* COST BASE, JULY 1978				

COST ESTIMATE SHEET

PROJECT Oliver Lock PLANT CAP. 16.33 MW DATE 27 May 83

JOB NO. ANN ENERGY 43,500 MKWH BY Lloyd

ACCOUNT NO.	DESCRIPTION	QUANTITY	UNIT COST	COSTS JULY 1978	Escalation Factor	COSTS DATE
333	WATER WHEELS, TURBINES AND GENERATORS TURB. TYPE GEN. TYPE RATING 16.3MW 21.5FT. D_2 FT. INSTALLAED COST (FIG 3-12 TO 3-16)	1		$5,500,000	1.49	$8,200,000 (Oct 82)
334	STATION ELECTRICAL EQUIPMENT TRANSFORMER, LIGHTING ARRESTOR, AIR BREAKER SWT, GEN. BREAKER AND LINE OCB (FIG. 6-3)......................			340,000	1.41	480,000
	BATTERY SYS., STA. SWT GEAR, STA. SER. TRANS.,BUS,CABLE CONDUIT, GRD., CONTROL BD., LIGHTING SYS., FREIGHT AND INSTALLATION (FIG. 5-4)...........................			650,000	1.41	920,000
335	MISC. POWER PLANT EQUIPMENT VENTILATION, FIRE PROTECTION, COOLING WATER, COMMUNICATION SYS., FREIGHT AND INSTALLATION (FIG. 6-5)...			140,000	1.38	190,000
350	TRANSMISSION LINE LENGTH MI VOLT. KV (FIG. 6-4)..............					
COST PER INSTALLED KW				SUB TOTAL		$9,790,000
	CONTINGENCY (25 %)					2,450,000
				SUB TOTAL		12,240,000
	ENGINEERING, CONSTR. MG. & OTHER COSTS (20%)					2,450,000
	TOTAL INSTALLED COST					14,690,000

EXHIBIT I
COST SUMMARY SHEET

PROJECT Oliver Lock
JOB NO.
DATE 27 May 1983

PLANT CAPACITY 16.3 MW
AVG. ANNUAL ENERGY 43,500 MWh
BY Meader

FERC ACCT. NO.	DESCRIPTION	COST* ($1,000)	ESCALATION FACTOR (Oct 82)	ESCALATED COST ($1,000)	TOTAL ($1,000)	
331	STRUCTURES & IMPROVEMENTS					
	SITE					
.11	DRAINAGE SYSTEM	2	1.38	$ 3		
.12	EROSION CONTROL	4		6		
.13	FINAL GRADING	7		10		
.14	ACCESS ROAD	25		35		
.15	PARKING & MISC. SITE FEATURES	48		67		
.16	ENVIRONMENTAL CONSTRUCTION CONTROLS	10		14		
.17						
.18						
	POWERHOUSE					
.21	STRUCTURAL	1,000	1.38	$1,380		
.22	EXCAVATION	54		75		
.23	FOUNDATION	100		138		
.24	SWITCHYARD	46		63		
.25						
.26						
	TOTAL, ACCOUNT 331				$1,791	
	* COST BASE JULY 1978					

FERC Acct. No.	Description 16.3 MW	Cost* ($1,000)	Escalation Factor (Oct 82)	Escalated Cost ($1,000)	Total ($1,000)
332	RESERVOIRS, DAMS & WATERWAYS				
.01	PENSTOCK	90	1.38	$124	
.02	VALVES	260		359	
.03	BIFURCATION & SLIDE GATES	40		55	
.04	TAILRACE	41		57	
.05					
.06					
	TOTAL, ACCOUNT 332				595
	TOTAL CIVIL COSTS				2,386
	CONTINGENCIES (25%)				597
	REGIONAL CORRECTION FACTOR				(.85)
	CORRECTED CIVIL COSTS				2,535
	ENGINEERING, CONSTRUCTION MANAGEMENT AND OTHER COSTS (20%)				507
	GRAND TOTAL				3,042
	* COST BASE, JULY 1978				

SAMRE-R
23 January 1983

REAL ESTATE ESTIMATE OF VALUE

ALTERNATIVE NO. 1

Fee Area	$3,475,000
Easement Area (work area)	535,000
Easement Area (disposal area)	335,000
	$4,345,000

ALTERNATIVE NO. 2

Fee Area	$1,875,000
Easement Area (work area)	535,000
Easement Area (disposal area)	305,000
	$2,715,000

ALTERNATIVE NO. 3

Fee Area	$1,415,000
Easement Area (work area)	535,000
Easement Area (disposal area)	105,000
	$2,055,000

APPENDIX A

SECTION V

COST ALLOCATION

A preliminary allocation using the Separable Costs - Remaining Benefits Method was made to estimate the costs assigned to navigation and hydropower features. The proportions of such costs to be borne by the local sponsor will depend on final policies agreed to by the President and Congress.

The Separable Costs - Remaining Benefits Method of allocating costs provides an equitable sharing of project feature costs, such as the cost of the dam, which both navigation and power need in order to function. This section presents details on the data used for allocation such as total projects costs, interest during construction, and operation, maintenance and replacement costs. It also presents costs specific for particular project functions and costs which are shared by both purposes as well as costs to construct each function individually at the proposed site and the cost of a powerplant removed from the river. The cost of the alternative single purpose powerplant was based on alternative thermal powerplant costs furnished by FERC.

Table A-V-1 summarizes pertinent data concerning the reservoir and dam. Table A-V-2 lists construction expenditures by feature for the multipurpose project and four alternative projects. The specific and joint costs for the functions of the multipurpose project are shown. Tables A-V-3 and A-V-4 demonstrate how interest during construction for expenditures specifically related to navigation and power was calculated using an interest rate of 7-7/8%. Interest during construction for joint costs is shown in Table A-V-5 with the trial percentage, for allocation noted. Operation, maintenance and major replacement annual costs are summarized in Table A-V-6 for the multipurpose project and the four alternative projects. Table A-V-7 lists total investment costs, annual charges and annual benefits for the proposed project and the four alternatives and shows the benefit cost ratio for all five. Separable and remaining joint costs are derived in Table A-V-8. Table A-V-9 is the allocation by separable cost -

remaining benefit method which draws on the previous tables. Table A-V-10 restates the conclusions of Table A-V-9. For application to financial records, the percentages for allocation of joint-use costs are summarized:

	CONSTRUCTION	O&M
Navigation	87.9%	59.5%
Power	12.1%	40.5%

TABLE A-V-1

Summary of Pertinent Data

Item	Multipurpose Project	Alternative Single Purpose Project		Multipurpose Minus Navigation	Multipurpose Minus Power
		Navigation	Power[1/]		
Reservoir					
Area, Acres	851	851	-	851	851
Storage, ac-ft	14,900	14,900	-	14,900	14,900
Upper Pool Elevation, NGVD	122.9	122.9	-	122.9	122.9
Lower Pool Elevation, NGVD	95.0	95.0	-	95.0	95.0
Disposal Area, Acres	139	134	-	32	139
Dam					
Spillway Crest Elevation, NGVD	122.9	122.9	-	122.9	122.9
Spillway Length, Feet	815.0	815.0	-	815.0	815.0
Installed Capacity, MW	16.3	-	-	16.3	-
Lock Dimensions, Feet	110x600	110x600	-	-	110x600

[1/] Alternative power plant was assumed to be a coal-fired steam plant.

TABLE A-V-2

SUMMARY OF CONSTRUCTION EXPENDITURES
($1000)

Permanent Features	Multiple Purpose Project				Alternative (at site) Multi-Purpose Project		Alternative Single Purpose Project	
	Specific Costs -Navigation-	Specific Cost -Power-	Joint Cost	Total Cost	Minus Navigation	Minus Power	Power	Navigation
Lands & Damages	900	700	1,400	3,000	2,100	2,300	400	2,300
Relocations	-	-	-	-	-	-	-	-
Reservoir	-	-	-	-	-	-	-	-
Dams	-	-	23,300	23,300	23,300	23,300	-	23,300
Spillway	-	-	(18,100)	(18,100)	(18,100)	(18,100)	-	18,100
Spillway Channel	-	-	(5,200)	((5,200)	(5,200)	(5,200)	-	(5,200)
Lock	78,400	-	-	78,400	-	78,400	-	78,400
Lock	(63,700)	-	-	(63,700)	-	(63,700)	-	(63,700)
Lock Approach	(14,600)	-	-	(14,600)	-	(14,600)	-	(14,600)
Spillway Removal	(100)	-	-	(100)	-	(100)	-	(100)
Cultural Resources	-	-	100	100	100	100	100	100
Road, Buildings Grounds and Utilities	600	100	-	700	100	600	200	600
Powerhouse	-	18,100	-	18,100	18,100	-	21,800 1/	-
TOTAL	79,900	18,900	24,800	123,600	43,700	104,700	22,500	104,700

1/ FERC Ltr. 9 May 83 gives coal-fired steam plant cost at $1,127 per kilowatt (with E & D at 11.3% and S & A at 7.5% a 16.3 MW plant should cost $21,800,000).

TABLE A-V-3

INTEREST DURING CONSTRUCTION (Specific Navigation)

PERIOD		EXPENDITURES ($1,000)				INTEREST DURING PERIOD (7-7/8%) ($1,000)
		During Period	At Beginning of Period			
Begin D.M.Y.	End D.M.Y.		Total	In-Operation	Interest Bearing	
01-04-85	30-09-85	200	-		-	4
01-10-85	30-09-86	900	200		200	51
01-10-86	30-09-87	18,100	1,100		1,100	799
01-10-87	30-09-88	19,200	19,200		19,200	2,268
01-10-88	30-09-89	19,200	38,400		38,400	3,780
01-10-89	30-09-90	19,200	57,600		57,600	5,292
01-10-90	31-03-91	3,100	76,800	1/	76,800	3,085
01-04-91	30-09-91	-	79,900	79,900	-	-
01-10-91	30-03-92	-	-	-	-	-
01-04-92	30-09-92	-	-	-	-	-
TOTAL		79,900				15,279

1/ In operation date Navigation Lock 1 Apr 91.

TABLE A-V-4

INTEREST DURING CONSTRUCTION (Specific Power)

PERIOD		EXPENDITURES ($1,000)				INTEREST DURING PERIOD (7-7/8% ($1,000)
		During Period	At Beginning of Period			
Begin D.M.Y.	End D.M.Y.		Total	In-Operation	Interest Bearing	
01-04-85	30-09-85	-	-	-	-	-
01-10-85	30-09-86	-	-	-	-	-
01-10-86	30-09-87	100	-	-	-	4
01-10-87	30-09-88	900	100	-	100	43
01-10-88	30-09-89	-	1,000	-	1,000	79
01-10-89	30-09-90	7,400	1,000	-	1,000	370
01-10-90	30-09-91	9,100	8,400	-	8,400	1,020
01-10-91	31-03-92	900	17,500	1/	17,500	706
01-04-92	30-09-92	500	18,400	18,900	500-	-
TOTAL		18,900				2,222

1/ Hydropower in operation 1 April 1992.

TABLE A-V-5

INTERREST DURING CONSTRUCTION (Joint Use)

Period		Expenditures ($1,000)				Interest During Period ($1,000)	
Begin D.M.Y.	End D.M.Y.	During Period	At Beginning of Period: Total	At Beginning of Period: In-Operation	At Beginning of Period: Interest Bearing		
01-04-85	30-09-85	300	-	-	-	6	
01-10-85	30-09-86	900	300	-	300	59	
01-10-86	30-09-87	4,300	1,200	-	1,200	264	
01-10-87	30-09-88	6,300	5,500	-	5,500	681	
01 10-88	30-09-89	4,300	11,800	-	11,800	1,099	
01-10-89	30-09-90	6,300	16,100	-	16,100	1,516	
01-10-90	31-03-91	1,300	22,400	- 1/	22,400	908	4,533
01-04-91	30-09-91	1,000	23,700	21,898	1,802	91	
01-10-91	31-03-92	100	24,700	21,898 2/	2,802	112	
01-04-92	30-09-92	-	24,800	-	-	-	
TOTAL		24,800				4,736	

1/ Navigation Lock in operation 1 Apr 91.

2/ Hydropower in operation 1 Apr 92.

Navigation costs = .883 x 24,800 = 21,898

Power cost = .117 x 24,800 = 2,902

Navigation IDC $\frac{21,898}{23,700}$ x 4,583 = 4,188

Power IDC 4,726 - 4,188 = 538

Trial percentages for allocation of joint costs

Navigation 88.3%

Power 11.7%

TABLE A-V-6

SUMMARY OF ANNUAL OPERATION AND MAINTENANCE AND REPLACEMENT COSTS
($1,000)

	Multiple-Purpose Project				Alternative Multiple-Purpose Projects (at site)		Alternative Single Purpose Project
	Specific Costs		Joint-Use	Total	Without Power1/	Without Navigation	Power
	Navigation	Power					
Operation and Maintenance							
Dam, Reservoir	-	-	$ 7	$ 7	$ 7	$ 7	-
Real Estate Management	$ 10	$ 8	10	28	20	18	$ 18
Roads	25	5	5	35	30	10	25
Locks	225	-	-	225	225	-	-
Buildings, Grounds & Utilities	55	20	40	95	95	60	60
Power Plant	-	225	-	225	-	225	256
Condition and Operation Studies	5	5	-	10	5	5	5
Surveys and Layouts	5	-	-	5	5	-	-
Supervision, Administration & Reports	75	40	-	115	75	40	75
SUBTOTAL	400	303	62	765	462	365	439
Major Replacements	60	75	-	135	60	75	75
TOTAL	$ 460	$ 378	$62	$ 900	$522	$ 440	$514

1/ Also appropriate to the alternative single purpose navigation project.

TABLE A-V-

SUMMARY OF COST, CHARGES AND BENEFITS
($1,000)

	Multiple-Purpose Project	Alternative Single Purpose Project		Alternative Multi-Purpose Project (at site)	
		Navigation	Power	Minus Navigation	Minus Power
Construction Costs 1/	$12_,500	$104,600	-	$43,600	$104,600
Interest During Construction					
Specific Power	2,222	-	-	2,222	-
Specific Navigation	15,279	19,467	-	-	15,279
Joint Use	4,736	-	-	4,736	4,188
TOTAL	22,237	19,467	-	6,958	19,467
Federal Investment	145,737	124,067	-	50,558	124,067
Average Annual Charges					
Interest & Amortization (7-7/8%)	11,742	9,996	-	4,073	9,996
Operation & Maintenance	765	462	-	365	462
Major Replacements	135	60	-	75	60
TOTAL	12,642	10,518	2,400	4,513	10,518
Average Annual Benefits					
Navigation	35,700	35,700	-	-	35,700
Power	2,400	-	2,400	2,400	-
TOTAL	$ 38,100	$ 35,700	$2,400	$2,400	$ 35,700
Benefit-to-Cost Ratio	3.0	3.4	1.0	0.53	3.4

1/ Minus $100,000 non-allocable cultural resources investigation.

TABLE A-V-8

DETERMINATION OF SEPARABLE AND JOINT COSTS
($1,000)

Item	Construction Expenditures	Investment	Annual Charge			
			Operation & Maintenance	Replacements	Interest & Amortization	Total
Multiple Purpose Project						
Total	$123,500 1/	145,737	$765	$135	11,742	12,642
Minus Power	104,600 1/	124,067	462	60	9,996	10,518
Minus Navigation	43,600 1/	50,558	365	75	4,073	4,513
Separable Cost						
Power	18,900	21,122	303	75	1,746	2,124
Navigation	79,900	95,179	400	60	7,669	8,129
Total	98,800	116,301	703	135	9,415	10,253
Residual Costs (Remaining Joint Costs)	$24,700	29,436	62	-	2,327	2,389

1/ Minus $100,000 non-allocable cultural resources investigations.

TABLE A-V-9
Allocation By Separable Cost-Remaining Benefits Method
($1,000)

ITEM	FUNCTION: Navigation	FUNCTION: Power	TOTAL
1. **Allocation of Annual Costs:**			
a) Average Annual Benefits	$35,700	$2,400	$38,100
b) Alternate Costs	10,518	2,400	-
c) Limited Benefits	10,518	2,400	12,918
d) Separable Costs	8,129	2,124	10,253
e) Remaining Benefits			
(1) Amount	2,389	276	2,665
(2) Percent	89.6	10.4	100%
f) Allocated Remaining Joint Costs	2,141	248	2,389
g) Total Allocation	10,270	2,372	12,642
2. **Allocation of Operation & Maintenance Costs:**			
a) Separable Costs	400	303	703
b) Allocated Joint Costs	55	7	62
c) Total Allocation	455	310	765
3. **Allocation of Major Replacements:**			
a) Separable Costs	60	75	135
b) Allocations Joint Costs	-	-	-
c) Total Allocation	60	75	135
4. **Allocation of Investment:**			
a) Annual Investment Cost	9,755	1,967	11,742
b) Allocated Investment	121,075	24,662	145,737
5. **Allocation of Construction Expenditures:**			
a) Specific Investment	95,179	21,122	116,301
b) Investment in Conventional Joint-Use Facilities	25,896	3,540	29,436
c) Interest During Construction On Conventional Joint-Use Facilities	4,188	548	4,736
d) Construction Expenditure In Conventional Joint-Use Facilities	21,708	2,992	24,700
e) Percent of Construction Expenditures in Conventional Joint-Use Facilities	87.9	12.1	100% %
f) Construction Expenditure In Specific Facilities	79,900	18,900	98,800
g) Total Construction Expenditures	$101,608	$21,892	$123,500

R/12/83

TABLE A-V-10

Summary of Allocated Costs
($1000)

ITEM	NAVIGATION	POWER	TOTAL
Construction Expenditures			
Total Allocation	$101,608	$21,892	$123,500
Specific Expenditures	79,900	18,900	98,800
Allocated Joint-Use Expenditures	21,708	2,992	24,700
Percent of Joint-Use Expenditures	87.9	12.1	100%
Operation and Maintenance			
Total Allocation	455	310	765
Specific Costs	400	303	703
Allocated Joint-Use Costs	55	7	62
Percent of Cost of Conventional Joint-Use Facilities	59.5	40.5%	100%

APPENDIX B

ECONOMICS

APPENDIX B

ECONOMICS

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APPENDIX B

ECONOMICS

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APPENDIX B
SECTION I

INTRODUCTION

PURPOSE

This appendix contains detailed data and analyses of the transportation economics analyses pertaining to a reevaluation of the Oliver Lock Replacement Project. The following sections and attachments document the evaluation procedures and provides estimates of the National Economic Development (NED) benefits which are expected to result from the proposed project.

The primary aim of this study was to estimate the navigation benefits which would reasonably accrue to the Oliver Lock Replacement over a 50-year project life (1990-2039). Cost and benefit data contained herein reflect October 1982 price levels. Average annual benefits were computed using a 7-7/8 percent interest rate.

SYSTEMS ANALYSIS

A major problem in the economic evaluation of a lock and dam project is the interdependence of traffic flows among the many individual elements of the system. In a system as diverse as the inland waterway system, a change in the performance capabilities of one lock or channel segment can affect the efficiencies of other components in at least two ways--by increasing aggregate service demands at other structures, and by changing the economic and physical characteristics of the traffic. Conversely, the capabilities of other components of the system can restrict traffic flows at the project under study and prevent the materialization of expected benefit streams.

The evaluation methodology and procedures employed in this study have been developed to measure total system performance. By evaluating the economic performance of the system for the existing and proposed improvement at Oliver Lock and Dam, the marginal system benefits attributable to this improvement can be measured. The project feasibility and benefits can then be determined.

For purposes of economic evaluation, the "system" is defined as the Black Warrior-Tombigbee Waterway, the Gulf Intracoastal Waterway System, the Lower Mississippi, the Lower Ohio, the Tennessee and the Cumberland Rivers. The Upper Mississippi, Missouri, Arkansas, Kanawha, Green, Monongahelia, Alabama Rivers and the Illinois Waterway were included in the system; however, at a much lower level of detail. For future year analyses, the system also included the Tennessee-Tombigbee Waterway, which is now under construction. The system should be viewed both from the context of the waterways' physical network, as described above, and the transportation infrastructure which utilizes this network.

The modeling system employed in this study consists of a series of inter-linked computer programs and simulation models. The basic components of the system are the Tow Cost Model (TCM), developed by CACI, Inc., and modified by the Huntington District, Corps of Engineers (COE), and the Waterway Analysis Model (WAM) also developed by CACI, Inc., and modified extensively by the Waterways Experiment Station (WES) and the Boeing Computer Services (BCS) under contract to WES.

The TCM is a fleet sizing and costing program that is a modified and expanded version of the original Flotilla Model, conceived as a part of the COE Inland Navigation Systems Analysis (INSA) program. The TCM is used to measure differences in the cost characteristics associated with different traffic levels and different system definitions. The model is static; therefore, iterative processing is required for introduction of the dynamics of time and change in traffic demands. Because the TCM uses values of capacity and a description of the delay relationship that are generated external to the model and because these factors are very important to the costs that are determined, an accurate means of determining these factors is required. However, capacity and the resulting delays are strongly affected by the fleet makeup and commodity flow patterns that are developed based on the system performance and commodity movement demands. Therefore, an interface was developed that allowed the WAM to simulate the system response to the traffic generated by the TCM based on the projected traffic movements. The WAM would determine the utilization of

the locks and the resulting delays by simulating in detail the lockage operations required to service the traffic movements generated by the TCM. In addition, the WAM was extended to determine the effects of constrained reaches of the waterway on the channel transit times. By iterating between the TCM and WAM, it is then possible to obtain an accurate measure of the changes in system costs and to estimate incremental changes in waterway rates under the conditions tested. For purposes of evaluating the resultant impacts on transportation rate savings and determining system traffic levels, a Marginal Economic Analysis Postprocessor was developed by the Huntington District, COE. By iterative use of this procedure, the effects of alternative improvements, the resulting traffic demand scenarios and traffic diversion criteria can be measured.

The purpose of this appendix is to provide an explanation of the steps involved in the procedures developed and the rationale used in the application. The information contained focuses on the general applications but stops short of a detailed description of the models. Additional information on the models and their application is available at the Mobile District, COE.

SYNOPSIS

Section II, entitled Model Process, describes the system used for this study and the sequential steps involved in determination of NED benefits. A flow diagram is provided and the paragraphs are keyed to applicable segments of the diagram.

Section III, entitled Model Application, describes in detail the actual modeled system. This includes discussing the generation of the shipment list and the projected traffic. All of the required model input data is described, as well as the sources and how the data were derived. Finally, the calibration of the model is discussed.

Section IV, entitled Results, describes the basic results of the systems analysis study. It discusses the overall results and the lock capacities that

were observed under the various conditions. Finally, the system tonnages and benefits are presented.

Section V, entitled Required Sensitivities, contains the results of the various sensitivity tests required by Principles and Guidelines, ER-1105-2-40, dated 8 January 1982. This includes the twenty-year project growth benefits, operations and maintenance cost recovery fees, capital cost recovery fees, and congestion fees.

Attachment 1, entitled Systems Analysis, provides a complete overview of the waterway system, and a general description of the characteristics of the waterway system operations. A discussion of the waterway service cost components and their sensitivity to traffic levels and system changes provides a basis for understanding the need to perform systems analysis studies.

Attachment 2, entitled Economic Model Conception, discusses applicable economic theory. An effort is made first to define the general nature of the supply-demand relationships for the system and towing industry, and to show the relative importance of system characteristics on the waterway's production function. It also includes a discussion of the development of the system's unconstrained freight-flow projections, the rate estimates and waterway service cost analysis.

Attachment 3, entitled Background on System Model Development, describes the historic development of existing models and the system selected for this study. It describes the shortcomings of existing models for use in the Oliver Lock Replacement Project and the modifications necessary to develop an acceptable systems analysis model.

Attachment 4 contains the data described in Section III. These tables were considered to be too voluminous for inclusion in the main body of the appendix.

This appendix is not intended to provide the necessary infromation to fully understand the detailed operations of the models used in the study.

APPENDIX B

SECTION II

MODEL PROCESS

SYSTEM SELECTED FOR THIS STUDY

Even though the Oliver Lock Study is focusing an improvement at just one small segment of the inland waterway, that improvement can have a much broader impact on surrounding segments of the system. Such is the case with Oliver. Even though the major impact of replacing Oliver is limited to the BWT Waterway, especially at Demopolis and Coffeeville Locks, the secondary impact reaches well beyond this area.

Based on the origin and destination patterns of affected traffic, the impacted system included the Black Warrior-Tombigbee Waterway, the Tennessee-Tombigbee Waterway, the Gulf Intracoastal Waterway East, the Lower Mississippi, the Lower Ohio, the Tennessee, and the Cumberland Rivers. The Upper Mississippi, Upper Ohio, Missouri, Arkansas, Kanawha, Green, Monongahelia, and Alabama Rivers and the Illinois Waterway and the Gulf Intracoastal Waterway West were also included in the defined system but at a much lower level of detail.

Figure 1 depicts the inland waterway system considered in the Oliver Lock Replacement Project. The portions of the system modeled in detail are delineated by the darkened locks.

MODEL FLOW DIAGRAM DISCUSSION

Figure 2 presents a diagram of the sequential modeling process used to analyze the Oliver Lock replacement study. Discussion on the various steps involved in this modeling process are contained in the following paragraphs which are numbered to correspond with items in the flow diagram.

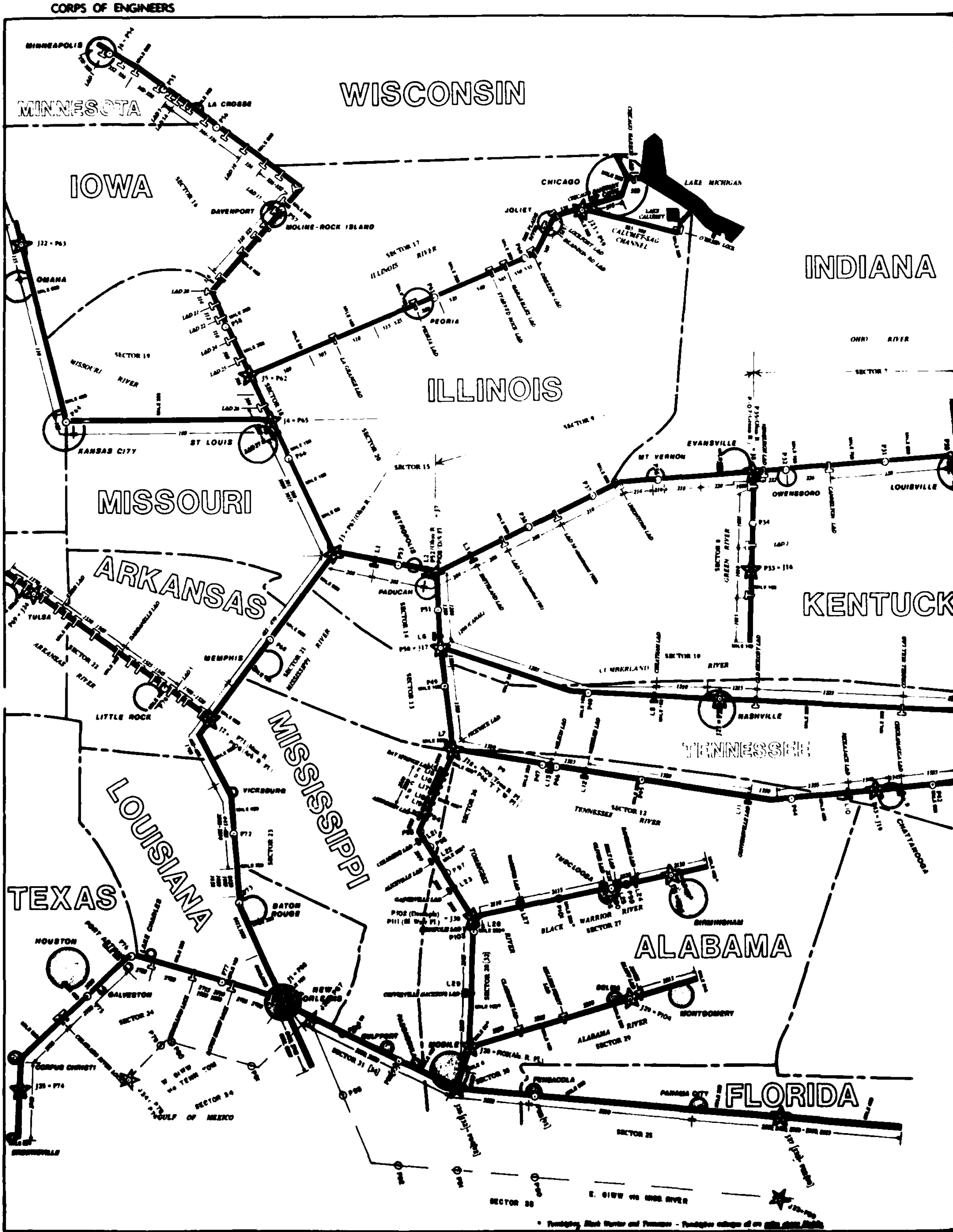
1. Shipment List - The shipment list is a data base of all dock-to-dock annual commodity movements reported for the impacted system to the Waterborne Commerce Statistics Center for the calendar year 1979. This data also includes the forecasted values for each movement based on 1980 OBERS projections developed by the Office of Business Economics. The movements projected in the 1976 Economic Reanalysis to move on the TTW were then added to the shipment list.

2. System and Equipment Description - The system and equipment description is a data base containing detailed information on the physical characteristics of the impacted system as well as cost and physical characteristics of the major commodity, transportation towboat, and barge classes. Information on the impacted system include lock dimensions and timings, port characteristics, river segment characteristics, fleeting points, and bend and bridge dimensions. This data served as input into both the TCM and WAM models.

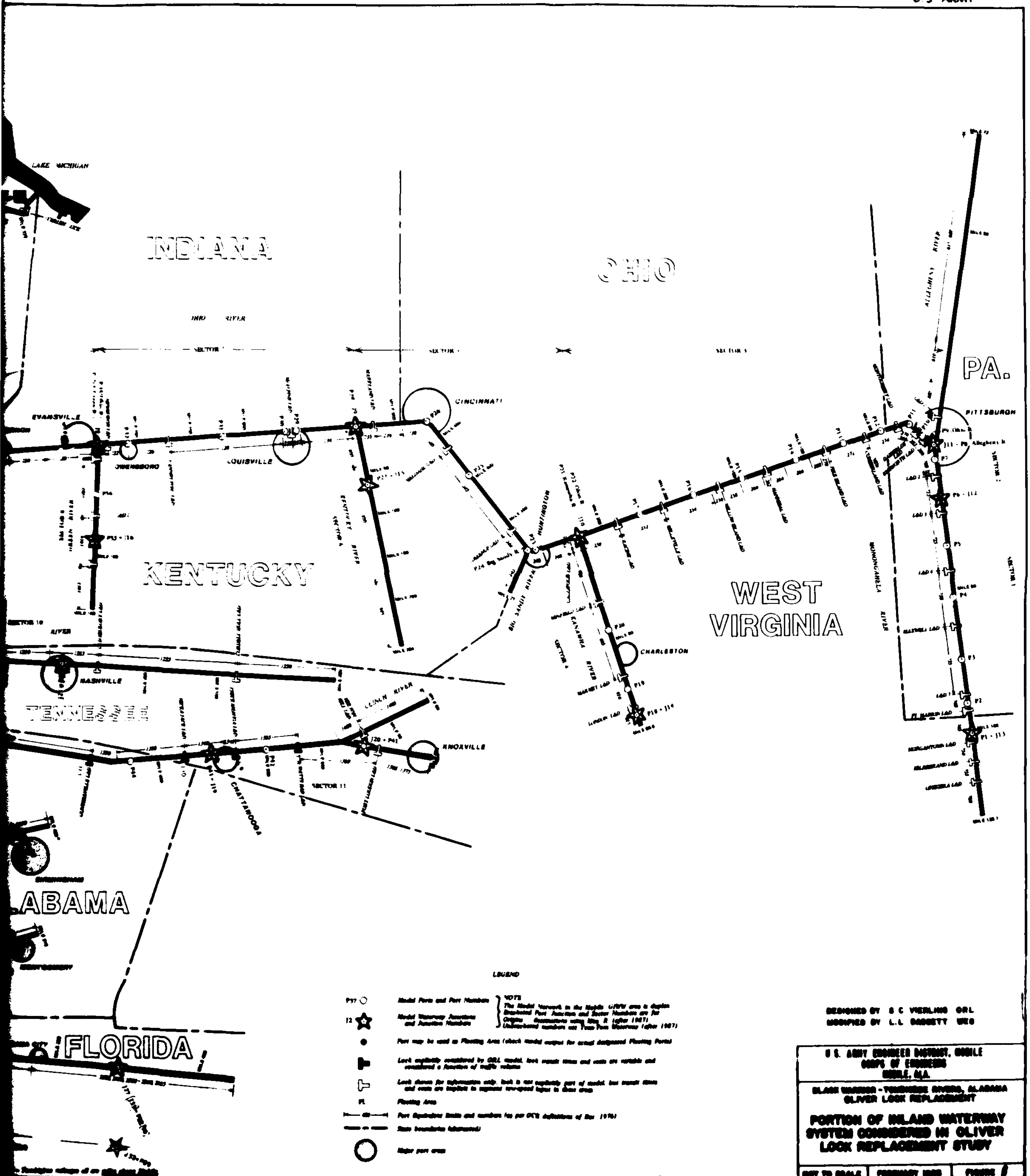
3. Tow Cost Model - The TCM optimizes the use of towing equipment based on the cost of movement through the waterway system for each year studied. The cost of movement is determined by the traffic characteristics in any given year. The pattern and volume of traffic in the system affect the opportunities for backhaul and the congestion at points of constraint (primarily locks). Normally as the costs of movement increase, the TCM generated tow size also increases. A maximum allowable tow size was specified for each river segment, based on physical characteristics. The TCM tow size will not grow beyond this level.

4. Tow Movements Through System - The tow movements through system is a tow generation program which utilizes the optimized towing equipment output and shipment list from the TCM. This program randomly generates movements which are input to the WAM. By utilizing the TCM output, the towing equipment is moving as efficiently as possible based on the system constraints and traffic patterns for each year analyzed. Generated data includes number of round-trips, the towboat class, barge type and tow size selected, the barge load

CORPS OF ENGINEERS



U.S. ARMY



DESIGNED BY G C VIERLING ORL
MODIFIED BY L.L. DAGGETT WES

U.S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
MOBILE, ALA.

BLACK WARRIOR - TOMBIGBEE RIVERS, ALABAMA
OLIVER LOCK REPLACEMENT

PORTION OF INLAND WATERWAY SYSTEM CONSIDERED IN OLIVER LOCK REPLACEMENT STUDY

NOT TO SCALE	FEBRUARY 1980	FIGURE 1

1 2

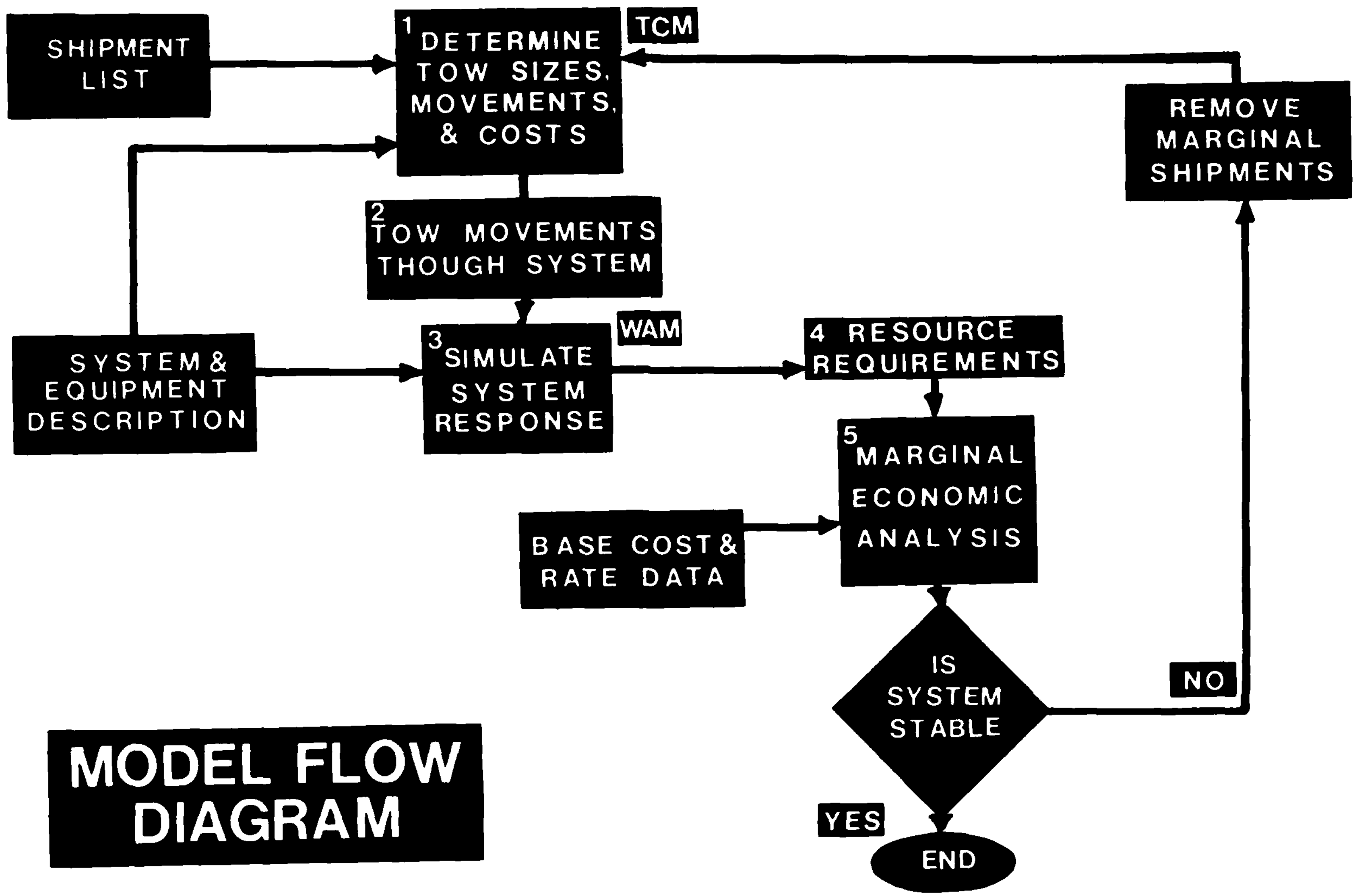

SHIPMENT LIST
1 DETERMINE TOW SIZES, MOVEMENTS, & COSTS
TCM
REMOVE MARGINAL SHIPMENTS
2 TOW MOVEMENTS THOUGH SYSTEM
SYSTEM & EQUIPMENT DESCRIPTION
3 SIMULATE SYSTEM RESPONSE
WAM
4 RESOURCE REQUIREMENTS
5 MARGINAL ECONOMIC ANALYSIS
BASE COST & RATE DATA
IS SYSTEM STABLE
NO
YES
END
MODEL FLOW DIAGRAM

Figure 2

allowed, and the empty backhaul factor for each segment of a transportation class movement.

5. Waterway Analysis Model - The WAM simulates the system response to the randomly generated traffic movements. Statistics on the timing and delays encountered in each segment by each generated dock-to-dock movement event are determined and recorded. For the purpose of analyzing the impact of replacing Oliver, a method of modeling tow transit through constricted bends was added to the WAM. Based on the traffic characteristics in any given year, the delays encountered as traffic increases at constraint points (locks, bends, and bridges) are added to the base condition (1979) times of each movement. The percent utilization and delays encountered at each lock in the impacted system is an output of this model. For each year studied the lock utilization and capacity is determined based on the traffic characteristics at each lock. For those locks experiencing congestion (Kentucky - Barkley, IHNC, Oliver, Coffeeville, and Demopolis) various combinations of nonstructural improvements, primarily lock operating policies, were tested to determine those with the greatest influence on increasing the lock capacity.

6. Resource Requirements - The resources requirement file contains the detailed movement data output from the WAM. It contains the number and tonnage volume of movements and associated transit times through various segments of the impacted system. This file contains the data on encountered delays that is used as input to the Marginal Economic Analysis (MEA) program which is used to determine the benefits attributable to the project implementation.

7. Base Cost and Rate Data - The base cost and rate data is contained in a file which is used as input to the MEA program. The rates reflect 1 October 1982 price levels and are associated on a one-to-one basis with all the movements in the shipment list. In addition, the base costs associated with each movement's transit through the system in 1979 are also contained in the file.

8. Marginal Economic Analysis - The MEA program uses costs associated with transit, locking, and delay times as developed by the TCM or as modified

by the WAM. As delays increase with growth in traffic levels or, as the system efficiency is improved through nonstructural or (in the case of Oliver) structural modifications, the base rate as determined in the rate survey is modified to reflect the resulting changes in linehaul costs. The MEA displays the transportation class movements ranked in order of decreasing marginal rate savings. It also displays traffic, cost, and rate savings data for movements common to user specified reaches of the impacted system. In this case, specified reaches were the BWT System, and Oliver, Coffeeville, and Demopolis Locks. If the system is stable, e.g., congestion is not building anywhere in the system and the delays encountered are what the traffic will bear, the results of the MEA determine the benefits. However, if the system is not reflecting a stable level of traffic, some movements need to be diverted and the entire modeling process is repeated until stability is achieved.

9. Remove Marginal Shipments - The remove marginal shipments step involves use of a diversion procedure.

The diversion procedure used in this study is based primarily on the marginal rate savings determined by the MEA analysis. The diversions are iterative. The diversion process involves two steps:

1. To reduce the projected traffic to a level within the capacity of a lock.

2. To eliminate movements with negative rate savings.

Movements that are "diverted" are in fact removed from the waterway shipment list even though the rate savings may have been based on an alternate waterway routing. Thus, diversion means removal from the inland waterway system. Because of the origin-destination pattern of the TTW movements (the only movements within an alternative waterway routing), the rerouting would not impact the TTW-BWT system locks. The rerouted TTW movements would begin or terminate at points on the BWT below Coffeeville, usually at Mobile, Alabama, or along the GIWW east of Mobile.

To bring a lock(s) into a level of traffic that can be processed by the lock(s), a tonnage level to be removed from the traffic passing through the lock(s) is specified. The shipment list is then reduced by the movements with the most negative rate savings per ton-mile being removed first. The procedure is accomplished in two passes. The first pass identifies the movements that pass through each lock having traffic reduced until each lock's requirement for tonnage reduction is met, starting with the movement with the largest negative rate savings per ton-mile value. Then a second pass is made through this subset of traffic, reordering the movements so that those movements that pass through more than one lock having traffic removed are selected first. Traffic is removed until each lock's traffic is reduced to the desired amount. If the last movement selected is larger than the amount required, the amount of tonnage remaining after satisfying the required reduction is left in the shipment list, i.e. the movement is split.

To reduce the traffic to a point that essentially no traffic remains on the system moving with negative rate savings, traffic movements are removed starting with the movement with the largest negative rate savings per ton-mile and working up the list until a desired level of traffic reduction is reached. Since the removal of this traffic will reduce operating costs for remainng traffic and, hence, some movements with negative rate savings could begin to operate with a positive rate savings, the reduction of traffic is accomplished in small iterative increments.

APPENDIX B
SECTION III

MODEL APPLICATION

MODEL INPUT DATA

The system definition used in this study is largely based on the system description used in the study of the Lower Ohio River system conducted by the Louisville District. This system was redefined to model the BWT and TTW in more detail and to reduce the emphasis on the Upper Ohio River and its tributaries. The major system components include the BWT, TTW, Tennessee, Cumberland, Lower Ohio, Lower Mississippi Rivers, and the East GIWW. The Upper Mississippi, Missouri, Arkansas, and Upper Ohio Rivers and tributaries and the Illinois Waterway and West GIWW are modeled to less detail, basically including representative reaches, ports and junctions. Locks on the Upper Mississippi, Illinois Waterway, Upper Ohio and tributaries and West GIWW are not represented explicitly.

This section will describe the model data required and identify the source of information used to obtain the data.

SHIPMENT LIST

The shipment list was derived from detailed dock-to-dock records reported to the Waterborne Commerce Statistics Center for the calendar year 1979. This was the latest data available at the time the study was initiated. Each record was encoded with the origin and destination Port Equivalent (PE) and Business Economic Area (BEA) codes in which the respective dock was located. The PE definitions used are the INSA definitions and were derived from an updated waterway point directory developed by this project. Using the BEA and the commodity codes, each record was assigned projection rates for the years 1990, 2000, 2010, 2020, and 2030. The projection factors were based on the 1980 OBERS projections developed by the Office of Business Economics. The movements projected to move on the TTW in the 1976 Economic Reanalysis of the TTW were then added to these movements. The projected movements are shown in Table 1 in Attachment 4.

Then these records were processed by a series of programs that prepared the shipments for use in the model. All movements that did not move on the primary systems being analyzed or through the locks included in the study were eliminated to reduce the size of the shipment list. PE's were converted into the port code used for the models and commodities were grouped into common classes. All movements with common origin and destination ports and commodity groups were aggregated into a single record, further reducing the size of the list. The selected year's projection factor was then applied to the aggregated tonnage and a shipment list for that year produced. Records with less than 6,000 tons were dropped from the list since it was found that these movements accounted for less than 1 percent of the total movements and removing them reduced greatly the size of the data files and the cost of executing the models runs. Dedication factors for particular movements were then added to the shipment record. The shipment list is now ready for use with the TCM.

SYSTEM DIMENSIONS

The system used in this study is a large system. It contains:

1. 20 river systems,
2. 34 sectors,
3. 111 ports,
4. 29 locks,
5. 31 chamber classes,
6. 180 reaches,
7. 73 bends,
8. 15 commodity classes,
9. 10 transportation classes,
10. 5 towboat classes,
11. 6 barge classes.

These system components are the same in the TCM and WAM and will be described below.

COMMODITY CLASSES

The WCSC commodities were grouped into 15 compatible classes for use in this study. The classes are the ones developed in earlier BWT and TTW analyses. For each commodity group a weighted average commodity value, holding or inventory factor, and density was developed from the values found for each of the individual commodities in the class weighted by the proportion of the total class tonnage. Also each commodity was assigned to a transportion class, which is described below. The commodity data used is shown in Table 2 in Attachment 4.

TRANSPORTATION CLASSES

The commodity classes are assigned to transportation classes in order to allow more efficient use of equipment. The transportation classes are made up of commodities that are compatible and that use similar types of equipment. Transportation classes are allowed to make use of the barges in backhaul situations when the opportunity exists. Each transportation class is assigned a handling class that determines the loading and unloading rates at the ports for the commodities. Handling classes were used to distinguish between liquids, dry bulk and granular bulk. The transportation class descriptions used are shown in Table 3 in Attachment 4.

TOWBOAT CLASSES

The operating fleet was represented in this study with five towboat groupings. Two 1,800 hp towboat classes were used to represent the motor vessels used on the BWT and the TTW. The difference in the description of these classes is the maximum tow each is allowed to push, the BWT tows are limited to six barge units and the TTW are allowed to push eight barge tows. A 3,100 hp and a 4,200 hp towboat represented the pusher units operating on the major rivers and their tributaries such as the Ohio and Upper Mississippi Rivers. A much larger unit was included to represent the larger class of motor vessels operating on the Lower Mississippi where tow sizes are typically much larger than other waterways.

Each towboat class is assigned a pushing power, a maximum tow size, dimensions, fuel consumption and variable and fixed costs. The dimensions used were typical of towboats of the horsepower range of the class. The fuel consumption and costs of operation were derived from data furnished by the OCE. This data is presented in Table 4 in Attachment 4.

BARGE CLASSES

The barge classes are used to describe the equipment used to move the commodities. When specialized equipment is used to move particular commodities, this equipment is usually dedicated to that particular commodity class. Six barge classes are used in this study. Many of the commodities on the BWT are moved in jumbo hopper barges. Petroleum is the primary commodity observed that uses super integrated barges. Therefore, the nominal barge class is defined as the jumbo barge.

A loading capacity, dimensions (including a loaded and empty draft), and variable and fixed costs are assigned for each barge class. Availablity factors and substituable barges can also be defined. Again the costs for the barge classes were obtained from the OCE furnished information. The barge characteristics used in this study are shown in Table 5 in Attachment 4.

PORT DEFINITION

The port definitions used in this study are basically the same port definitions used in the Louisville study. The differences occur in two places. The BWT and TTW port definitions used in the Lower Ohio River study were expanded to include a port for each lock pool on the BWT and one for the BWT below Coffeeville Lock and Dam. Also the port definitions used to define the alternate routing possibilities were modified to allow a more appropriate emphasis on the routing potentials. The ports were defined as groups of PE's. Typically all PE's in a lock pool were included in a single port unless a PE is on another river system. Ports are used primarily for defining the points of origin and destination of movements, for routing information, and for loading and unloading operations and statistics. The port definitions used in this study are shown in Figure 1 located in Attachment 4.

Each port is assigned the following properties:

1. A barge pickup/dropoff time, including a fixed tow turnaround time,
2. A loading and unloading rate for each of the handling classes,
3. An average port delay experienced for each tow,
4. And an average towboat waiting time.

Since the ORD studies had conducted surveys in order to determine normal port characteristics and no additional data was available, the values used for these parameters in the Louisville study were used here. The characteristics are shown in Table 6 in Attachment 4.

LOCK DEFINITION

The lock definitions used in this study were selected to identify the interactions of BWT and TTW traffic with the traffic at other locks in the system. Thus the 29 locks used in this study include all of the locks on the BWT, TTW, and the Tennessee River and the first locks on the connecting waterway routes. Both Locks and Dam 52 and 53 are included because both locks are subjects of ongoing studies for improvement and potentially could be affected by the availablilty of the TTW.

Because of the importance of the locking times and delays to the system analysis results, considerable effort was committed to obtaining the best data available to describe the lock and chamber characteristics. A complete analysis of the BWT Performance Monitoring System data for 1979 was performed using LOCKOP and JUNIBLD programs developed by the Louisville District. In addition, the PMS data for 1980, 1981, and 1982 were also analyzed for this system. The PMS data for 1980 from the Inner Harbor Navigation Canal (INHC) lock was also analyzed in detail using the same programs. Data for the existing TTW locks from 1980 and 1981 were analyzed also; however, there were very few lockages performed at these locks. LOCKOP results for selected locks on the Tennessee River for 1980 were obtained from an analysis that Louisville was performing at the time data was being gathered for this modeling effort.

Locks included in this analysis were Kentucky, Barkley, Pickwick, Wilson, and Chickamauga locks. A special LOCKOP report was available for a short period at Wilson Locks when the main chamber was down for repair work and the auxillary chamber, which is rarely used, was being used for locking. No PMS data was available for the Smithland Locks since they had not been functioning for the time period that valid PMS data was available. The latest PMS data available for the Locks and Dam 52 and 53 were from 1976; Louisville District did not recommend using PMS data after that year.

The results from these annual PMS reports was used to derive the data required for the TCM and WAM models for the BWT and IHNC and Tennessee River Locks. For those locks on the Tennessee River that were not included in the analysis, estimated values were derived from those locks most nearly compatible with the missing locks' characteristics, considering primarily the adjacent locks in order to maintain compatible traffic characteristics. The Smithland Locks and the Locks and Dam 52 and 53 information was obtained from the Lower Ohio River study input data.

The method of modeling the Kentucky and Barkley Locks and Dams requires special notice. Since the TCM does not allow direct modeling of networks with loops, it was not possible to model exactly the Lower Ohio, Tennessee, Cumberland Rivers and Barkley Canal Loop. However, because the Barkley Canal is relatively short and since the Kentucky and Barkley pools are essentually one pool, the Kentucky and Barkley Locks were modeled as a dual chamber lock. This is the same procedure used in the Lower Ohio River analysis.

Most of the locks in the system were assigned a first-in/first-out operating policy. Demopolis and Coffeeville were assigned a policy of 1-up/1-down since this was found to be more efficient. Kentucky/Barkley, Chickamauga, IHNC, Demopolis, Coffeeville, and Oliver Locks were modeled with detailed lockage times, while all others were modeled using the simplified lockage time computations. Using detailed lockage times allowed the modeling of multi-vessel, ready-to serve lockage policies and recreational traffic. Recreation traffic was modeled at IHNC in an attempt to account for the large number of lightboat and miscellaneous traffic that passes through that lock. No open-pass

conditions were modeled but these operations were implicitly included in Locks and Dam 52 and 53 lockage times.

For future years without project condi ions, operational characteristics at Demopolis, Coffeeville, and Oliver were modified. The locking times were shortened to reflect estimated improvements in approach times at these locks with increased efficiency of operations at these locks and the installation of mooring cells where feasible to assist in the lockage process. In addition, the lock size and timings were changed for the Oliver Lock for the future years with the project to represent the design lockage component times. The new lock chamber being constructed at Pickwick Lock was also included in future year runs.

The details of the locking input data used for the calibration conditions are displayed in Tables 7, 8, 9, and 10 in Attachment 4.

RIVER SEGMENT DEFINITION

Statistics generated during the modeling can be aggregated and reported as river systems. As noted earlier, twenty river segments were defined for this study. A listing of these segments is presented in Table 11 in Attachment 4.

SECTOR AND LINK DEFINITION

River segments are made up of groups of sectors. The sectors consist of groups of links connecting ports, locks and junctions. Thirty-four sectors were defined in this study. Each sector consists of ports, locks, bends, and river reaches. A sector will normally have some consistent characteristics that are defined when the sector is defined. A name is assigned to each segment and the sector is assigned to a river segment. Properties such as the average current speed, the average and minimum depths, tow speed coefficients, maximum tow size, and towboat capacity are defined for that sector. Each link is defined by the beginning and ending node, which is either a port, lock, junction or bend terminator. The characteristics of the reach are defined in the same manner as the general sector characteristics. The additional data

item required is the length of the sector. Bends also require the definition of the bend radius, width, clearance width and a maximum tow length before requiring a flanking operation. A special prototype study was conducted to determine the transit speeds through the bends as a function of the bend radius and navigation conditions. The sector and link definitions used for this study are presented in Table 12 presented in Attachment 4.

ROUTE SPECIFICATION

The sequence of sectors to be transited in order to proceed from the origin port to the destination port is defined in the route specification table. It is this table and the use of dual port definitions for particular sectors, i.e., the GIWW, that allows the routing of some traffic via the Lower Mississippi and some via the TTW. The definitions used are presented in Table 13 presented in Attachment 4.

MODEL CALIBRATION

The calibration of a simulation model is an important step in the study process. In this study the calibration procedure primarily involved the TCM. The calibration involves comparing the model results with the observed characteristics of the system and adjusting characteristics of the model so that it more closely represents the observed conditions. Properties used for evaluation of the models performance in this process included the tonnage passing through the locks, the number of tows and barges locked, the distribution of lockage types, the distribution of tow sizes and loading of tows, the percent of empty barges locked, and the utilization of the lock. The following changes were made in the calibration process:

1. increased the capacity and draft of the barges types,
2. replaced the 1,000 hp tow type with an 1,800 hp tow type with a six-barge capacity,
3. adjusted the dedication factors on the BWT and the IHNC,
4. changed the maximum tow size on the BWT and IHNC,
5. adjusted the routing on the lower Ohio River,

6. increased the density of coal, and

7. relocated the fleeting point between the TTW and the Tennessee River.

Though it would be desirable to have multiple years in the calibration verification, the data was not available to run multiyear tests. Due to the unavailability of acceptable 1979 PMS data at IHNC, 1976 and 1980 data had to be substituted for calibration purposes. PMS data problems were encountered at other locks in the system, including 52, 53, and Smithland. It was also found that PMS data problems were present in other years at various locks throughout the system. In view of the overall problems, the 1979 data was considered to be most appropriate for the calibration process.

The results of the calibration presented in Table 1 compare the values obtained from PMS and lockmaster data with the values obtained from model calibration runs. With the exception of the problems discussed in the following paragraphs, the calibration produced acceptable results. Further investigation of the problem areas (IHNC, Oliver, and Chickamauga) revealed that the level of difference was explainable and/or within an acceptable range.

As mentioned previously, the TCM is an optimization model which determines the optimum tow size for a system considering the cost per movement on any given segment of the system. The towing industry, not having knowledge of the market at all times, lags behind the optimum tow size. TCM determined that a 3.9 barge tow size was the optimum for BWT traffic based on the cost characteristics of movements in 1979. The actual average tow size for the waterway in that year was 3.5. However, in 1980 the average tow size did in fact grow to 3.9 barges per tow in May and June. Average tow size for 1980 was 4.1 barges per tow. The effect of the larger tow size on all locks other than Oliver is a decrease in the percent utilization since fewer tows, and hence lockages, were required for the given level of tonnage. However, due to the increase in double lockages resulting from more four and six barge tows, the utilization at Oliver would be higher. The TCM results reflect this relationship. A functional relationship of utilization to tow size was developed based on the

Table 1

CALIBRATION RESULTS

LOCK	TONNAGE (MTONS) PMS	TCM	TOWS PMS	TCM	BARGES PMS	TCM	EMPTY PMS	TCM	% UTILIZATION PMS	TCM	DELAY (HR) PMS	TCM
L&D 53	57.418	60.417(5.2)	8204	7998(-2.5)	---	69056	--	43	--	18	---	0.3
L&D 52	65.870	70.748(7.4)	10110	9324(-7.8)	76836	79139(3.0)	--	38	--	28	---	2.6
SMITHLAND	64.717	68.392(5.7)	---	9646	---	80613	--	41	--	40	---	0.7
IHNC	22.286	21.056(-5.5)	12460"	11329(-9.0)	27412"	24664(-10.0)	49	50(1)	85	81(-4)	4.4	4.6
KENT/BARK	31.515	31.051(-1.5)	4456	4539(1.9)	40263	39299(- 2.4)	47	46(1)	52	49(-3)	3.2	2.8
PICKWICK	14.867	14.749(-0.8)	1979	1769(-10.6)	20254	18912(- 6.6)	45	45(0)	--	44	1.0	1.1
CHICKAMAUGA^	1.518	1.150(-24.2)	426	371(-12.9)	2224	1613(-27.5)	48	47(-1)	29	26(-3)	0.7	0.7
WILSON	7.932	7.341(-7.5)	1177	971(-17.5)	9016	8489(- 5.8)	40	39(-1)	32	23(-9)	0.4	0.5
BANKHEAD	9.543	9.589(-0.5)	2230	2348(5.3)	8006	9144(14.2)	31	23(-8)	20	22(2)	0.2	0.1
HOLT	11.796	11.990(1.6)	2823	2951(4.5)	10428	---	29	30(1)	27	23(-4)	0.3	0.2
OLIVER	11.948	12.230(2.4)	3075	3032(- 1.4)	10872	11876(9.2)	29	31(2)	48'	44(-4)	0.9	0.8
WARRIOR	12.078	12.398(2.6)	3032	3087(1.8)	10765	---	29	31(2)	25	21(-4)	0.3	0.2
DEMOPOLIS	11.531	11.783(2.2)	2820	2942(4.3)	10426	11481(10.1)	28	30(2)	25	20(-5)	0.3	0.1
COFFEEVILLE	11.954	12.115(1.3)	3080	3059(- 0.7)	10897	11961(9.8)	29	30(1)	24	21(-3)	0.1	0.2

CALIBRATION RESULTS, (Part 2)

LOCK	TONS/TOW PMS	TCM	BARGES/TOW PMS	TCM
L&D 53	---	7554	---	8.6
L&D 52	6515	7588(16.5)	7.6	8.5(11.8)
SMITHLAND	---	7090	---	8.4
IHNC	1768"	1859(-5.1)	2.2	2.2(0.0)
KENT/BARK	7028	6841(- 2.7)	9.0	3.7(- 3.3)
PICKWICK	7512	8339(11.0)	10.4	10.7(2.9)
CHICKAMAUGA	4058	3103(-23.5)	5.7	4.4(-22.8)
WILSON	6739	7563(12.2)	7.7	8.7(13.0)
BANKHEAD	3847	4083(6.1)	3.6	3.9(8.3)
OLIVER	3879	4034(4.0)	3.5	3.9(11.4)
DEMOPOLIS	4053	4005(1.2)	3.5	3.9(11.4)
COFFEEVILLE	3785	3960(4.6)	3.5	3.9(11.4)

'This was the utilization experienced at Oliver in 1980 when average tow sizes of 3.9 barges per tow were observed.
"Based on 1976 PMS barge loadings per tow at IHNC.
^Percent error at Chickamauga appears excessively high due to low traffic volume. This error stems largely from tonnage discrepancies between PMS and WCSC data.

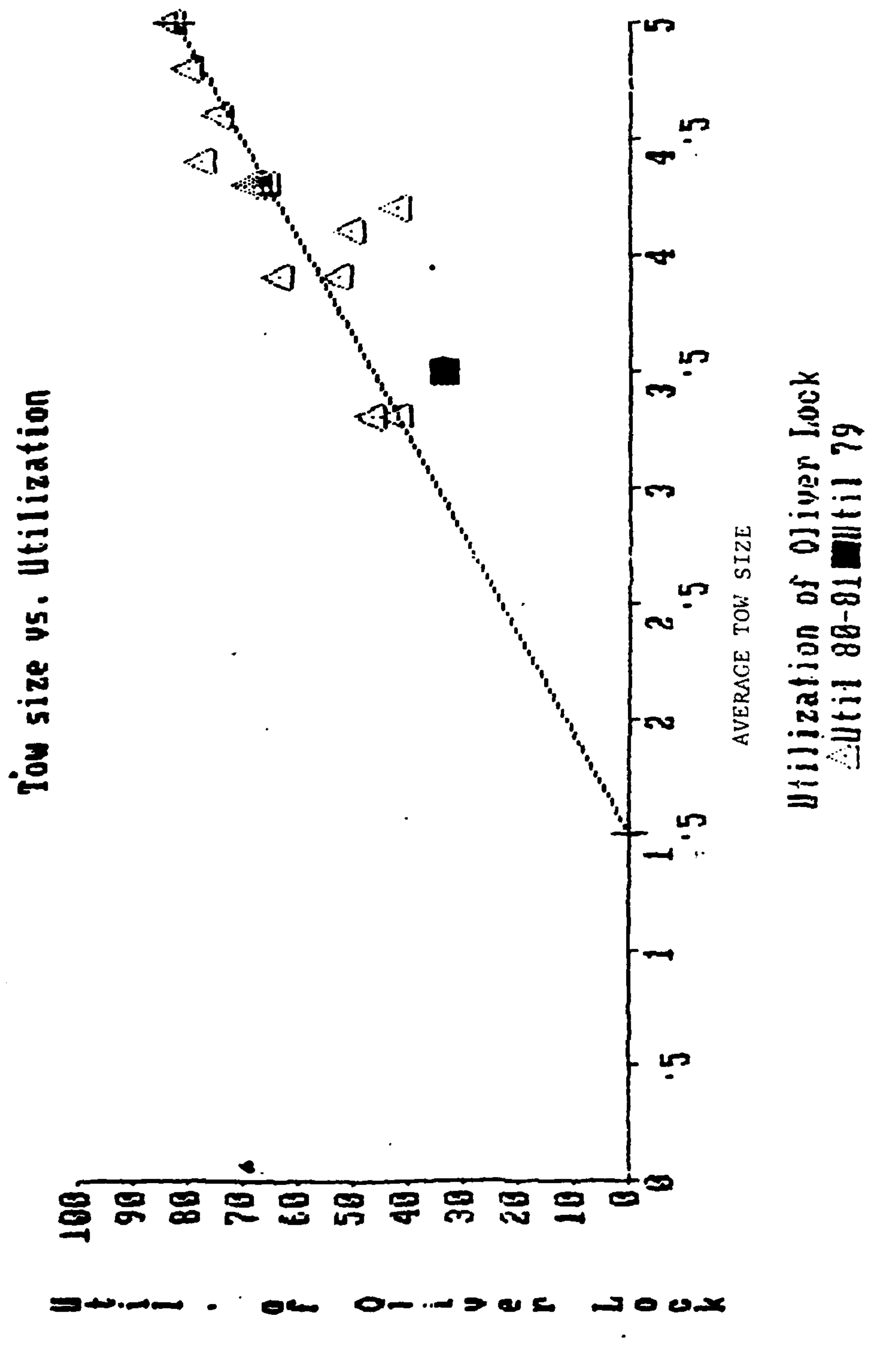
actual experienced utilization associated with average tow sizes in 1979 and various months in 1980 and 1981 and is presented in Figure 3. The percent utilization at Oliver associated with a 3.9 barge tow would be approximately 48 percent. This compares to a 44 percent utilization computed by TCM.

It should be noted that the 44 percent utilization represents an unimproved Oliver with no nonstructural improvements since none were in use in 1979. The 1979 data was also run for comparison purposes, with the nonstructural improvements at Oliver. With the mooring cells, industry self-help, ready-to-serve, and 1 up- 1 down combination implemented, the utilization associated with a 3.9 barge tow size was 28 percent, a significant savings over the unimproved Oliver.

With Chickamauga, a small lock on the Upper Tennessee River, a relatively low volume of traffic (1.5 million tons in 1979 according to PMS data), proved to be difficult to calibrate. In terms of percentage, the simulation base year tonnage at Chickamauga was considerably below the tonnage levels observed at the lock and this caused all of the other parameters to be low. It appears that the major discrepancy is between the Waterborne Commerce data and PMS data for that year. Since the origin and destination of the missing traffic was unknown, no attempt was made to artificially boost the tonnage level at this lock. Because the tonnage level was low, TCM found it more efficient to use smaller tows for the movements. Various attempts were made to improve the agreement of the tow size data. It was discovered that changing the tow size at this lock also adversely affected the other Tennessee River lock tow sizes. Therefore, the TCM results shown in Table 1 were utilized for study purposes.

Another reason this error in calibration was tolerated, was due to the significant impact anticipated at this lock by the TTW traffic. In 1990 the TTW is forecast to add approximately 6 million tons of traffic to this lock, which will comprise about 70 percent of the total traffic. This, in effect, changes all basic parameters causing the TCM to reoptimize based on TTW traffic characteristics. For example, the percent utilization jumps from the mid-twenties in 1979 to 87 percent in 1990 as a result of the addition of TTW

Figure 3



Tow size vs. Utilization
AVERAGE TOW SIZE
Util. of Oliver Lock
Utilization of Oliver Lock
Util 80-81 Util 79

traffic. Assuming that the rate of growth for the missing traffic is the same as that for the remaining traffic (less TTW), differences in total tonnage in 1990 would be approximately 8.4 percent, an acceptable level.

The Inner Harbor Navigation Canal Lock (IHNC) was another lock that proved to be a problem in obtaining an acceptable level of calibration. Since 1979 data was not available, 1980 PMS data had to be used for comparison with 1979 WCSC traffic data. This was not a significant problem since the tonnage differential was within an acceptable level (5.5 percent). In addition, the barges per tow were identical and the percent empty, percent utilization, and hours of delay were within an acceptable range. However, the tons per barge reflected by the TCM were considerably higher than that recorded by PMS (1859 vs 1521) leading to approximately 20 percent fewer barges and tows with the TCM. It was learned that the average loading per tow in 1980 had decreased from previous years, though the reason for this drop was not known. Further investigation revealed that the average loading per tow in 1976 (the year used for the IHNC replacement study) was considerably closer to the TCM value (1768 vs 1859, or a difference of 5.1 percent). LMVD considers that the 1976 PMS data are more reflective of the typical operations at the IHNC in a peak year. Using the 1768 tons per tow, the difference in the recomputed PMS number of tows and barges and those reflected by the TCM is 9 and 10 percent, respectively. This level of difference was determined to be acceptable for study purposes.

BASE YEAR COST DEVELOPMENT

Once the calibration was completed, the base year cost data base must be computed. This data base will be used to adjust rates in the future year analysis. The results from the TCM calibration run were processed by the Resource Requirements Program Postprocessor program (PP1). This computed the costs of operation under the modeled calibration conditions. These costs were then processed through the MEA program to associate the base rate data with the modeled cost data and the base year cost data file was saved. This file will be used with all future MEA runs to compute the adjusted rates and rate savings under future conditions.

FUTURE YEAR RUNS

The procedure followed for all future year modeling is described in this section. The traffic for the year being modeled is extracted from the shipment data base and the observed dedication factors are applied to each movement. This shipment list is then processed for the system with the Oliver Lock replaced and with improvements at the Demopolis and Coffeeville Locks.

The shipment list is processed by the TCM. A movement file for the WAM is then created, a WAM model run is made, the postprocessor program is then executed to generate the new estimated cost file (including combined operational time data from the TCM and WAM), and the MEA program is executed to create the estimated rates and rate savings. A comparison is made between the TCM and WAM results at the locks to determine if the capacity of any locks was exceeded and if significant differences existed in the modeled lock utilization or delay and lockage times. If a lock capacity was exceeded, then the required tonnage is removed from the projected shipment file until an estimated capacity tonnage level at those locks is reached. The method described above is used to remove this tonnage. If a discrepancy is found between the TCM and the WAM results, and adjustment is made to the TCM capacity, processing times, or delay factor to allow for changing traffic characteristics. The process is repeated until all locks are within their capacity and the results from the TCM and WAM are compatible.

Then the shipment file for the future year is used to begin modeling the system without replacement of Oliver Lock and improved operating conditions at Demopolis and Coffeeville. The procedure described in the paragraph above is repeated until the tonnage through the Oliver Lock is within the capacity as determined by the WAM.

The MEA results from the with and without conditions are the compared to determine the benefits of the replacement of Oliver.

NONSTRUCTURAL IMPROVEMENTS

Because of the congestion problems expected to occur at Oliver Lock under without project conditions, the following nonstructural improvements were assumed to be in effect at the lock during the 50-year project life:

-Mooring Cells
-Industry Self-Help
-Ready-to-Serve
-1 Up - 1 Down.

These improvements were built into the estimated locking components times for modeling purposes rather than modeled explicitly.

In addition, due to congestion problems at other key locks on the system under both with and without project conditions, various combinations of non-structural improvements were tested and those which were found to have the greatest influence on increasing capacity were considered to be in place during the 50-year project life. These were:

Kentucky-Barkley

-Ready-to-Serve
-1 Up - 1 Down
-3 tow bias wait for Kentucky before utilizing Barkley

Coffeeville and Demopolis

-1 Up - 1 Down
-Improved approach and locking times

Inner Harbour Navigation Canal

-First In - First Out (found to be comparable to 1 Up - 1 Down)
-Multitow Lockages

Chickamauga

-Ready-to-Serve

It should be noted that a ready-to-serve policy is only appropriate at those locks experiencing multicut lockages. Such is not the case at the IHNC, Demopolis, or Coffeeville.

One structural change was introduced into the system for both with and without Oliver replacement modeling runs. Since an additional lock chamber is under construction at Pickwick Lock, the 1000- by 110-foot lock chamber was considered to be in place for all future condition tests.

POTENTIAL CONSTRAINT PROBLEMS OTHER THAN LOCKS

Tow potential constraint problems other than locks were addressed. These were the possibility of water shortage problems at Holt Lock and Dam and the 73 bends and bridges below Demopolis identified by the Corps and towing representatives as potential congestion points. These issues were addressed during the study effort and were subsequently dismissed when they were found to not be significant. However, the effects of the bends and bridges on overall transit times of traffic utilizing the BWT were included in the analysis. Results of the analyses performed on both the water shortage and bend congestion issues will be briefly discussed.

WATER SHORTAGE

The possibility of a water shortage at Holt Lock and Dam results from analysis of monthly flow duration curves. The lowest average monthly flow during the year has historically been experienced during the month of October. PMS data for the river indicated over the 1976 - 1980 period about 8.8% of annual traffic passed through the lock during October. The projected increase of traffic on the river at Holt Lock was converted into the number of required emptyings of the lock during October and compared to the available water. It was concluded that at the initial year of the Oliver project regulatory

measures would have to be taken to allow uninterrupted flow of traffic during the month of October for approximately 10% of the time. It was further concluded that the measures such as water conservation and recirculation, pump back from the downstream pool or upstream impoundments were not advisable at this time as they entailed large expenditures for maintaining about 1 percent of the annual traffic on the river. The concern about possible water shortages was dismissed at this time due to its insignificant impact on traffic.

BEND AND BRIDGE CONSTRAINTS

As discussed above, 73 bends and bridges on the lower BWT below Demopolis were identified as being potential congestion problems. There were modeled in the WAM and the congestion at each was monitored as traffic increased over the 50-year project life. It was found that not one of the bends realized a delay substantial enough to warrant improvements. Based on the results of this analysis, it was determined that the primary constraints on the waterway were the locks rather than the bends. For example, in 2000, under with project condition the average delay at the most congested bend was only 0.14 hours. However, the effects of bends and bridges on overall transit speed of tows and the delays at these points were included in the economic analysis.

The following example presents the tonnage and major transportation classes diverted at key locks experiencing constraint problems for two key years during the project life under both with and without project conditions:

(M Tons)

	Years				Major
	With Project		Without Project		Transportation
Lock	1990	2010	1990	2010	Classes
Kentucky/Barkley	.4	9.3	.7	9.3	1, 8, 10
IHNC	9.3	20.7	10.7	20.4	1, 2, 7, 8
Chickamauga	.3	5.1	.2	3.1	1, 8
Demopolis	1.5	16.9	8.4	30.1	1, 8
Oliver	.1	.8	7.3	16.6	1

APPENDIX B

SECTION IV

RESULTS

The systems analysis study demonstrated that the benefits resulting from the replacement of the Oliver Lock continue to be large even with the TTW traffic sharing the lower BWT. The system benefits are presented in Table 2. The system benefits reflect the difference between the cumulative rate savings at the point of zero marginal rate savings for the with and without project systems. In addition, the BWT benefits are also included in Table 2. This reflects savings to traffic using the BWT at some point in its movement but not including traffic that did not use the BWT. Finally, the last benefit figure reflects the rate savings and benefits for the traffic that passed through the Oliver Lock.

It can be observed that generally the overall benefits to the waterway begins at about $30.1 million and continues to grow to $42.0 million in the year 2010. It is also noted that the benefits to the Oliver and BWT traffic grow at a more rapid rate with the benefits to the Oliver traffic being $50.8 million in 2010. However, the benefits to the total system traffic are much lower indicating that while the Oliver traffic realizes substantial benefits, other traffic have much smaller rate savings. It should be noted that for purposes of this analysis traffic projections were leveled off in 2010 and held constant for the remainder of project life. It is recognized that as a projection is extended further out in time, the credibility is increasingly weakened. Many agencies, such as Bureau of Mines and Department of Energy, limit their projections to 20-25 years in the future. Sensitivity requirements in ER 1105-2-40 dated 8 January 1982 also acknowledge the unreliability of distant year projections. Therefore, projections and benefits are limited to the first 20 years of project life.

Table 2

Benefits

Oliver Lock Replacement Project

(Millions of Dollars)

	1990	2000	2010	2039
System Benefits	$ 30.1	34.8	42.0	42.0
BWT Benefits	29.1	32.4	44.2	44.2
Oliver Benefits	30.7	35.3	50.8	50.8

Benefits for the total system were used to compute the project benefits (the first set of columns in Table 2). Based on these benefits, the average annual equivalent project benefits, computed at a 7-7/8% percent interest rate, total $35,700,000. As discussed in the main body of the report this results i a benefit-to-cost ratio of 3.5.

Another important result of the analysis is the identification of locks in the system that cannot process all of the projected traffic (see Table 3). It was found that the IHNC Lock could not pass the projected traffic in even the first future year, 1990. Its' capacity was found to be about 27 million tons. Changing capacities for locks were evident in most cases and appeared to be a result of changing backhaul characteristics and fleeting changes from the TCM. Kentucky/Barkley and Chickamauga Locks were found to reach capacity early in the simulated future. This included full utilizatior of the Barkley Lock, something that industry is not doing at the present time.

The locks with the most influence on constraining TTW traffic are Kentucky Lock on the Tennessee River and Barkley (a parallel lock) on the Cumberland River.

Kentucky-Barkley capacity was found to be constrained at approximately the 90 million ton level primarily because of the constraint problems of the Lower Cumberland River. The towing industry has been reluctant to use the waterway due to the severe current and bend problems. A six-barge tow is currently considered to be the largest tow size that can use this portion of the Cumberland. As a result, the 110' by 800' chamber at Barkley is vastly underutilized. Another factor affecting the capacity at Kentucky is the heavy use of 15-barge tows forcing double lockages at the 110' by 600' chamber.

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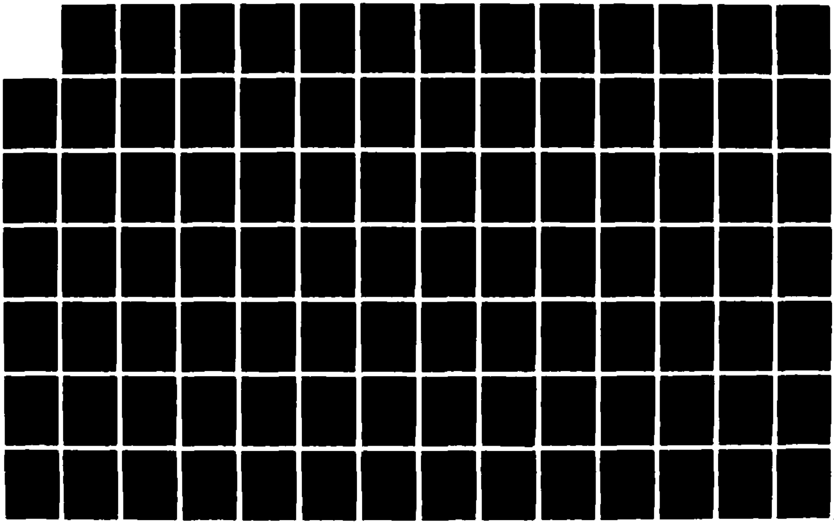

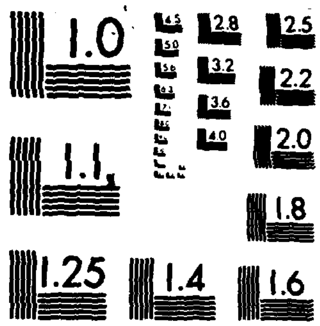

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

TABLE 5

SYSTEM TONNAGES

	WITHOUT PROJECT					WITH PROJECT				
	1990	2000	2010	2020	2030	1990	2000	2010	2020	2030
L&D 53	96.8(35)	111.2(22)	125.8(46)	125.8(46)	125.8(46)	96.8(35)	110.5(20)	125.9(44)	125.9(44)	125.9(44)
L&D 52	116.5(51)	133.8(61)	151.8(68)	151.8(68)	151.8(68)	116.4(51)	133.1(57)	151.8(60)	151.8(60)	151.8(60)
SMITHLAND	128.1(75)	148.1(85)	166.1(89)	166.1(89)	166.1(89)	127.9(75)	147.9(83)	165.8(90)	165.8(90)	165.8(90)
IHNC	24.5(93)	26.5(95)	26.6(94)	28.6(94)	28.6(94)	25.9(96)	26.3(89)	28.3(93)	28.3(93)	28.3(93)
KENT/BARK	69.2(80)	81.0(91)	85.5(94)	85.5(94)	85.5(94)	69.5(80)	80.1(90)	85.4(95)	85.4(95)	85.4(95)
PICKWICK	38.7(29)	45.4(39)	48.4(40)	48.4(40)	48.4(40)	38.8(29)	44.4(39)	48.5(40)	46.5(40)	48.5(40)
CHICKAMAUGA	7.7(74)	9.2(82)	8.4(82)	8.4(82)	8.4(82)	7.6(77)	8.8(96)	6.5(64)	6.5(64)	6.5(64)
WILSON	27.5(83)	32.2(47)	28.5(58)	28.5(58)	28.5(58)	27.5(84)	31.1(44)	26.8(68)	26.8(68)	26.8(68)
BANKHEAD	17.2(26)	16.6(25)	12.4(18)	12.4(18)	12.4(18)	19.1(31)	21.5(35)	27.2(45)	27.2(45)	27.2(45)
HOLT	18.2(34)	17.8(32)	20.1(34)	20.1(34)	20.1(34)	24.9(54)	28.4(55)	35.8(77)	35.8(77)	35.8(77)
OLIVER	18.3(96)	18.2(97)	20.6(99)	20.6(99)	20.6(99)	25.5(51)	28.8(53)	36.4(78)	36.4(78)	36.4(78
WARRIOR	18.5(33)	18.5(29)	20.7(32)	20.7(32)	20.7(32)	25.7(47)	29.1(48)	36.4(68)	36.4(68)	36.4(68)
DEMOPOLIS	42.7(75)	49.5(84)	43.9(76)	43.9(76)	43.9(76)	49.6(88)	56.8(96)	57.1(95)	57.1(95)	57.1(95)
COFFEEVILLE	43.2(73)	50.2(81)	44.2(71)	44.2(71)	44.2(71)	50.1(84)	57.5(91)	57.5(89)	57.5(89)	57.5(89)
GAINESVILLE	29.5(53)	37.6(74)	30.9(60)	30.9(60)	30.9(60)	29.6(53)	34.4(69)	28.6(52)	28.6(52)	28.6(52)
BAY SPRINGS	28.9(47)	35.3(57)	28.7(45)	28.7(45)	28.7(45)	28.9(44)	33.2(56)	26.5(41)	26.5(41)	26.5(41)

The capacity levels determined by the WAM (which included nonstructural improvements) are in agreement with findings of lock capacity studies performed by ORD.

Of particular importance to this study were several other capacity values. The present Oliver Lock was found to be at capacity in the first decade, 1990. While the capacity grew, probably due to the factor mentioned above, from about 18 million tons to about 21 million tons, it did not match the capacity of the other locks in the BWT through which most of the traffic must pass. Also, the capacity of the Demopolis and Coffeeville Locks were not exceeded even with the replacement of Oliver. This apparently was due to the limitations as IHNC, Kentucky/Barkley, and Chickamauga Locks. Finally, the constrained bends on the lower BWT that were of initial concern proved to not be a serious constraint. Delays from these bends were an order of magnitude smaller than those caused by the locks. One of the reasons is probably due to the traffic control function provided by the Coffeeville and Demopolis Locks.

APPENDIX B
SECTION V
REQUIRED SENSITIVITIES

ER 1105-2-40 dated 8 January 1982 requires that certain sensitivity analyses be performed as a test of the project's feasibility. These include halting traffic growth at 20 years, assessing the impact of user fees to recapture systemwide O&M costs, assessing the impact of a capital cost recovery fee for the project under study, and consideration of the relative feasibility of a congestion fee alternative. Each of these analyses is discussed in turn in the following paragraphs.

Twenty-Year Benefits. For purposes of this analysis forecasted traffic and benefits were leveled off at the 20-year (2010) level and held constant. The resulting average annual benefits total $35,700,000 yielding a benefit/cost ratio of 3.5 to 1.

User Fees. The Administration has proposed legislation (S.1554) to recapture 70 percent of the annual operations and maintenance costs associated with maintaining the inland waterway system. If implemented, it would result in an assessment of 1.1 mills per ton mile beginning in October 1984. Since this cost represents a transfer of costs from one sector of the economy to another, it does not affect the NED benefits. However, since it does represent an increase in operating costs to the individual towing companies it affects the marginal movements, thus resulting in diversion of some movements which otherwise would have continued using the waterway system.

This analysis was accomplished following guidance provided in draft EC 1105-2-123. Benefits were grown at a rate of 4.5 percent per year to reflect inflation. The 1.1 mill per ton mile systemwide O&M fee specified in S.1554 is also grown at 4.5 percent, less 2.5 percent estimated annual system traffic growth, or 2 percent net.

As shown in the table below, the analysis shows no significant impact on traffic through imposition of the systemwide O&M fee. Even without adjustments for inflation, the amount of diverted traffic is small compared to the total system tonnage.

YEAR	TOTAL KTONS	TOTAL KTON-MILES	DIVERTED KTONS W/O INFLATION	DIVERTED KTONS W INFLATION	DECREASE IN KTON-MILES W/O INFLATION	DECREASE IN KTON-MILES W INFLATION
1990	242,973	173,447,253	11,257	10,735	9,367,443	8,685,522
2000	275,362	193,050,654	15,155	8,038	12,596,237	5,240,779
2010	305,600	215,925,995	11,526	5,257	10,929,250	3,601,143
2020	305,600	215,926,995	11,526	4,936	10,929,250	3,288,489
2030	305,600	215,926,995	11,526	3,257	10,929,250	1,598,286
2039	305,600	215,926,995	11,526	1,395	10,929,250	1,062,632

Cost Recovery Fee. In S.1554, the Administration has also proposed that 70 percent of the average annual capital cost of the project be recaptured through a user charge. As in the case of the user fee to recover 70 percent of annual O&M charges, the capital recovery fee does not represent a decrease in NED benefits but, rather, a transfer of cost from one sector of the economy to another.

The methodology prescribed in draft EC 1105-2-123 was used to perform this analysis. The impact on traffic was analyzed both with and without adjustments for inflation. This fee represents an addition to the O&M recovery fee and is applied to the rate savings remaining after application of the O&M recovery fee to the Oliver traffic that was not diverted in the above analysis. As shown in the table below, the impact of the segment specific lock replacement cost under both conditions is insignificant. Therefore, the project is viable throughout the 50-year project life.

YEAR	TOTAL K TONS	TOTAL KTON-MILES	DIVERTED KTONS W/O INFLATION	DIVERTED KTONS W INFLATION	DECREASE IN KTON-MILES W/O INFLATION	DECREASE IN KTON-MILES W INFLATION
1990	25,479	10,212,596	38	18	24,094	11,034
2000	28,828	11,104,567	47	23	29,771	14,099
2010	36,393	14,380,813	0	0	0	0
2020	36,393	14,380,813	0	0	0	0
2030	36,393	14,380,813	0	0	0	0
2039	36,393	14,380,813	0	0	0	0

Congestion Fee Analysis. System benefits presented in Table 15 reflect the equilibrium traffic level (average rate savings (ARS) = average towing costs (ATC)). At this level, the marginal shipper would be indifferent as to his choice of mode, since the waterway shipping costs and costs via an overland mode are equal. The marginal shipper pays his average towing costs at equilibrium; however, his true marginal cost is considerably higher. The optimum level of traffic (also known as the "social optimum") would be realized by restricting system traffic to the level where the rate savings of the marginal user just equals his marginal towing cost (ARS = MTC). Lock congestion fees and other similar nonstructural traffic rationing (demand management) have been proposed as a means of attaining the socially optimum traffic level on a congested waterway.

The rate savings and barge shipping costs for each prospective movement are a function of the total system routing. Therefore, determination of the optimum traffic level requires a knowledge of the average rate savings and average system towing costs for all traffic that would transit Oliver Lock at the equilibrium system traffic level as well as the marginal system towing cost for each Oliver movement. At the equilibrium traffic level, the marginal economic analysis program also provides a listing of all system movements ranked from highest to lowest unit rate savings as well as the total system rate savings.

The rate savings for each movement (and for the system total) for any given year have been adjusted to include the average barge linehaul costs on the system reflected by WAM. Therefore, average system towing costs require no further consideration. In order to determine the existence of marginally inefficient movements (MTC > ARS) at Oliver at the system equilibrium level, additional increments of Oliver traffic were simply diverted (in order of willingness-to-pay) beginning at the equilibrium ranking. For each additional increment of diverted traffic, the entire system modeling process was repeated. Output from the iterative runs was then used to identify incremental changes in the total system rate savings and the portion of total system saving attributable to Oliver traffic.

Where diverted Oliver traffic movements (at the system equilibrium level) exhibited marginal towing costs in excess of rate savings, the diversion process would result in system rate savings. Conversely, diversion beyond the social optimum would result in a decline in total system rate savings. Through this iterative process, the social optimum traffic level was determined for Oliver Lock. The total system rate savings with Oliver traffic restricted to the social optimum were then compared to the total system rate savings at the equilibrium level to determine the incremental benefits for a congestion fee at Oliver. The amount of the congestion fee to be imposed at Oliver is determined by computing the difference in the ARS of Oliver traffic at equilibrium vs. the social optimum system traffic levels.

The resulting benefits are shown below for various years during the project life.

YEAR	SYSTEM BENEFITS
1990	7,783,000
2010	11,253,000
2039	11,253,000

The gross average annual system benefits from imposition of a congestion fee total 9,462,000, considerably less than the benefits realized from lock replacement. It should be noted that this analysis erroneously assumes zero costs of imposition and maintenance of this fee.

APPENDIX B

ATTACHMENT 1

SYSTEMS ANALYSIS

In the past, the planning, design, and maintenance of the Nation's waterways have been performed on an individual basis, generally in isolation of other related functions and without regard to their effects on other parts of the total navigation system involved. However, current conditions make it quite clear that in this time of limited funds and stringent national priorities, a systems analysis of waterways is desired and required. A need also exists, particularly with today's advanced technology, to experiment with nonstructural improvements including traffic control and regulation to improve present operations and to better plan and program major contruction. The interrelationships between the various components of a waterway system are so complex and the data requirements to develop such interrelationships are so voluminous that any approach to a complete systems analysis must necessarily be computer oriented.

To meet these needs, the COE, with the aid of various private economic and systems analysis consultants, has developed several transportation, economic and statistical models and techniques which are useful in the analysis of a complex nationwide or regional transportation system. In general, these techniques have been designed to help COE planners achieve two goals:

1. to operate and maintain the inland waterway network as effectively and efficiently as possible, and

2. to select the best size, location, and timing of inland waterway improvements.

It should be understood that the use and knowledge of these systems analysis techniques are accelerating, and that many of the models and other analytical "tools" now available are still in developmental stages.

Application of a particular model to any given study effort generally requires custom "tailoring" of the model or its data base to best fit the given study purposes and available data, and to allow for timely and cost-effective model execution.

SYSTEM DESCRIPTION

NATURE OF THE SYSTEM

The Oliver Lock and Dam is a part of the Black Warrior-Tombigbee (BWT) Waterway system and is located at Mile 346 on the Black Warrior River within the city limits of Tuscaloosa, Alabama. The lock is the smallest lock on the system with dimensions of 460 ft x 95 ft, compared to 600 ft x 110 ft for all the other locks on the BWT. The BWT is primarily a local system with most of the traffic moving between points on the BWT to or from Mobile and other points on the East GIWW. However, when the TTW begins operation, most of the traffic using the TTW will be sharing the lower Tombigbee River with the BWT traffic. Much of the TTW traffic will pass through locks on the Tennessee and Ohio Rivers and other tributaries of the Ohio. The TTW will provide an alternate waterway route to the Lower Mississippi River, thus potentially influencing the Lower Ohio River below the junction with the Tennessee River. There is some interchange of traffic between ports in or near New Orleans and the East GIWW that passes through the Inner Harbor Navigation Canal (IHNC) Lock.

Therefore, for purposes of this study, the "system" was defined based on a determination of which segments of the inland waterway system could potentially be impacted to any significant degree by the project. Preliminary analysis of the commodity movements affecting the Oliver Lock and Dam and other portions of the waterway system over which Oliver traffic moves narrowed the principal components of the system to the following waterways: BWT, TTW, Tennessee, Lower Ohio, Lower Mississippi and the GIWW East. All other segments of the Mississippi River-Gulf Coast inland waterway system were found to be extraneous to the purpose of this study, and therefore, were included at a much lower level of detail in the study. It was found through further analysis that the major

impacts of the proposed improvement would be limited to the BWT Waterway, particularly Coffeeville and Demopolis Locks. However, as the Oliver Lock replacement was found to have some degree of impact on the marginal system benefits, the remainder of the system was included in the analysis. The system definition used in this study is presented in Figure 1 which displays the significant waterways and the port definitions. All major locks on these principal waterways are included.

CHARACTERISTICS OF WATERWAY SERVICE

Waterway service is provided on the BWT by five primary carriers. While this indicates that competition might be limited, this is not the case. In the last several years, new operators have begun to move on the BWT and have influenced the manner in which the carriers function. Some of these carriers began operations on the BWT in anticipation of the opening of the TTW; it is anticipated that many other carriers will begin operations as the time for opening the TTW is approached. Throughout the entire inland system, over 2,000 carriers are engaged in waterway transportation service. In size, they range from owner-operators of a single towboat to managers of very large fleets of both towboats and barges. In recent years, financial institutions have developed investment plans whereby individuals can purchase shares in a single barge. The competitive nature of the towing industry is exemplified by the concern which most firms express regarding the quotation of barge races. In the view of most operators, wide dissemination of contract rates on barge service would seriously jeopardize their respective competitive positions.

The characteristics of waterway service vary from operator to operator, depending upon the contractual arrangements under which carriage is performed. Many shipments are performed under contracts which are designed to minimize turnaround time for movements in a single direction. Under these conditions, backhaul movements appear to be discouraged because of the time required in each delivery cycle by the operator to line-up a backhaul movement, for additional time loading and unloading of the backhaul shipment, and if required, barge cleaning activities. Equipment used in this type of service is generally

dedicated to a specific directional movement between a specified pair of origins and destinations. This kind of dedication is most generally applicable to coal shipments. Backhaul movements also have been discouraged for this type of dedication from an institutional point of view, where the waterway equipment is owned and operated by a holding company for shipment of its own commerce, generally coal for electric generating plants.

Another type of dedication observed on the inland waterways is often applicable to chemical and petroleum products. This involves the multidirectional movement of commodities among various origins and destinations, where production, consumption (or overland distribution) and waterway shipment are accomplished within a single managerial organization. This type of dedication arrangement allows for backhaul shipments where the compatibility of barge types exist and where the potential for reverse-direction shipments is available within the corporate structure. However, because of the differences in the characteristics of the various chemical and petroleum products, special barge cleaning efforts are often required, and backhauls are again often discouraged.

Thus, backhaul potentials in the inland waterways tend to be limited by the commodity flow potential and associated equipment requirements. Petroleum products moving from Gulf Coast refineries into the BWT basin use barge equipment for which there exist few compatible commodity flows in the reverse direction. Crude petroleum is moved from the BWT basin to these refineries; however, this product cannot be mixed with the refined petroleum products and frequently does not use the same equipment. Shippers of coal downbound to major coal consumers and for export at the lower BWT, Mobile, and Gulf Coast area can in some cases find suitable backhaul movements with metallic ores being shipped to the Birmingham area, but this potential is limited to the amount of each product being shipped. Some chemical products require specially designed barges which limits or eliminates the potential for use in shipping other chemical products. Generally speaking, the longer the waterway haul distance, the more inclined the operator is to search for backhauls. This is simply due to the fact that for l nger transit times, the proportion of total

cycle time required for barge cleaning, backhaul loading and backhaul unloading is smaller than for short hauls and with a long waterfront there is a larger potential for locating backhaul movements. Many of the movements on the BWT are local to the system and therefore the opportunities for backhaul are limited and the percent of time for backhaul turnaround is large compared to the linehaul time. The introduction of large coal and grain movements when the TTW opens will probably increase the percent of empties due to the lack of backhaul potential.

Most waterway towing companies have well-organized dispatching systems. Operational headquarters are constantly aware of the location and condition of every towboat and barge in their fleets, as well as any equipment obtained on a contract, lease, or rental basis. As explained by one towing company, each towboat contacts its headquarters on a scheduled basis throughout the day. Towboat captains are advised of towing conditions along the route, and changes to towboat operating procedures, changes in routing plans, and revisions to barge pickup and drop-off orders.

Each waterway operator employs methods and procedures for optimizing equipment utilization which are tailored to the particular geographic area of operation, contractor requirements, and other factors affecting the services provided. Differences in management philosophy, preferences in technology, and scale of operation are reflected in operating plans. One carrier may plan his operations around the use of small or medium size towboats assigned to the same tows from points of origin to destination. A second carrier may develop his operation to use larger towboats from origin to destination. Still another operator may assign towboats of different sizes to different reaches of the waterway system depending upon the origin and destination characteristics of a shipment, it may be handled by two of more towboats during the routing. Obviously, this latter type of operation requires a rather large scale of operation not commonly found on the BWT, but is often preferred where traffic volumes permit and where large differences in tow sizes can be achieved, e.g., along a GIWW-Lower Mississippi-Ohio River route. Most movements on the BWT are performed with one size towboat, primarily 1,800-2,000 hp. When the TTW is

opened it is expected that the tows will be refleeted above Demopolis Lock and Dam and will probably involve an exchange of towboats.

WATERWAY SERVICE COST COMPONENTS

To some extent, the waterway transport industry is akin to the motor carrier industry. Like the highway system, the waterway system is available to whomever wishes to use it. Institutional and physical impediments affecting entry to and exit from the industry have generally been negligible. Consumers of waterway service may supply their own equipment, and historically have done so. As stated previously, production units (firms) are sometimes small in size. Within certain bounds, economic limitations to capacity expansion within a production unit are not great because such expansions can occur in small units by purchase of additional towboats, barges, and waterside facilities.

In certain other respects, the towing industry departs from the characteristics of motor carriage and takes on traits of the rail industry. While it is obvious that the costs of the waterway system over which the industry operates remain largely outside of the towing industry cost structure, it is important to note that waterway towing equipment is not nearly as sensitive to obsolescence and depreciation as is motor carrier equipment. Even with the tremendous expansion in the fleet required to accommodate the 60 percent increase in traffic since 1960, the existing equipment is somewhat aged. For example, towboats currently in use on the inland waterway system have an average age of about 19 years. The age of the 2,300 standard open hopper barges in use on the system averages 20 years. Some of the equipment dates to the early 1930's. Barge equipment in use on the Great Lakes and East and West Coasts is even older.

Stated very simply, the short-term fixed cost of waterway service per unit of output functionally determined by the following factors:

-value of towing equipment used;
-physical capacity of equipment used;

-proportion of equipment capacity used;

-physical constraints of the waterway system;

-institutional constraints on waterway service;

-probability of accident or loss;

-management and supervision requirements;

-interest on investment; and

-the fronthaul-backhaul relationship.

Variable costs of waterway service per unit of output is functionally related to:

-value of labor;

-value of fuel;

-value of supplies;

-time equipment is in use;

-schedule of maintenance and repairs;

-proportion of equipment capacity in use;

-probability of accident or loss; and

-institutional constraints on waterway service.

When actual capital outlays are used in these relationships, the resultant costs are financial in nature. When opportunity costs are used in lieu of capital outlays, the result becomes economic costs.

It is difficult to make broad generalizations about the cost structure of the industry that are meaningful. Each movement must be considered independently. The operational pattern for each waterway operator is developed in a manner which takes into consideration an array of factors that influence the production function for that particular firm. The resultant unit costs are highly variable from one movement to another. Competition inherent within the industry, an imbalance in the directional characteristics of traffic demands, and differences in towing conditions throughout the system make such variations a natural characterization of the industry.

SENSITIVITY OF COST TO AGGREGATE SYSTEM TRAFFIC LEVELS

Waterway's user costs are also related to overall system traffic levels. This can be illustrated by way of an example:

Consider a commodity movement from point A downbound to point B. Downbound transit time is initially 80 hours and upbound time is 100 hours.

The example movement must share use of the system with other waterway movements. A high aggregate level of traffic over this reach can cause congestion, particularly if the reach encompasses one or more lock and dam structures, which would affect the transit time of the movement. Suppose that the waterway between point A and point B contained six lock and dam structures each with average lockage times of 1 hour. Then, about 7.5 percent of downbound transit time between A and B is required for lockages and 6 percent of upbound time is for lockages. If overall traffic growth throughout the reach increases average time required for each lockage to 2 hours because of queues at each lock, then transit time from A to B increases by 7.5 percent and transit time from B to A increases by 6 percent. If only one of the six structures has less capability than the others, such that lockage and queue times grow to 30 hours while the others remain at 2 hours each, then the total transit times would increase by 44 and 35 percent for A to B and B to A, respectively.

Obviously, the increases in transit times translate to increased user costs. For each shipment cycle, not only are personnel and equipment tied-up for longer periods of time, but additional crews and equipment purchases may be required to move a given annual volume of traffic.

Another aspect of the relationship between aggregate traffic levels and costs for individual waterway movements entails the variability of origin-destination characteristics. The origin-destination addressed in the example originally had transit times of 80 hours downbound and 100 hours upbound. Suppose, however, that the movement in question had a much longer haul,

involving 400 hours downbound and 600 hours upbound. For such a movement, a 35-hour increase in transit time in either direction would have a much smaller impact on total shipping cost than for the shorter movement.

All other things being equal, continued increases in queue times at a constricted lock would eventually force movements for which costs are most severely impacted to seek alternative routings or modes of transport. Those movements with costs less severely affected would continue the water routing with greater capital investment and marginally higher unit costs.

SENSITIVITY OF COSTS TO SYSTEM CHANGES

It should be clear from the above example that any change made to the physical system which results in a reduction in transit time favorably impacts upon waterway service costs. By reducing total time in a shipment cycle, it also reduces the total investment in equipment required to provide the same level of service. If the system change entails improvements at a single lock and dam component of the system, then the relative impacts differ from one movement to another, depending upon the origin-destination characteristics and total haul distance. Short-haul movements which are most sensitive to localized delays at a single component of the system are obviously most sensitive to improvements made to alleviate congestion at that structure.

NONWATERWAY COSTS

To this point, only those costs associated with waterway shipment have been discussed. More important to the consignee is the delivered price of the commodity being shipped. In addition to the costs of waterway service, other costs associated with transportation affect delivered price. These include costs for overland shipment to or from the waterway, loading, unloading, transloading, and any other assessorial charges required to complete the routing. The importance of these costs and charges are reflected in the fact that over 90 percent of all waterway movements on the BWT have off-river origins, destinations or both. For some commodities, this proportion is much higher. About

90 percent of all coal movements are intermodal, and obviously all grain shipments originate off-river. Most petroleum fuel shipments are ultimately destined for the service station.

The effect of nonwaterway costs is to reduce the sensitivity of the final delivered price of a commodity to any changes in waterway service costs. The extent to which this occurs depends upon at least two factors:

-the relationship between delivered price and waterway service costs; and

-the relationship between total transportation costs and waterway service costs.

APPENDIX B

ATTACHMENT 2

ECONOMIC MODEL CONCEPTION

ECONOMIC CHARACTERISTICS

The waterway system is comprised of a series of navigable natural rivers and pools with a draft and width fixed by law. The pools are often maintained by lock and dam structures having fixed lock sizes and service times. The physical specifications of the system dictate to a large extent the maximum physical product of the system. In most cases, the total system physical product is constrained more by the lock components than by pool and channel configurations.

The production function for the system actually entails a host of individual functions representing the specific commodity and origin-destination demands placed upon the system. Each has its own cost curve depending upon the number and location of components of the system used and the extent to which they are used. Some movements require more lockage time than others simply because of tow configuration and/or size.

Waterway industry physical output can be defined in a number of ways. Units of equipment moved on the system is a convenient measure of system and project operating efficiency. However, equipment movement does not always correspond to the direct delivery of cargo. Tons of cargo delivered is a more meaningful measure of output and would be suitable for systems analysis purposes, were it not for the fact that cargo movements travel over different distances and segments of the system in response to unique components of the demand schedule. The unit of output which captures distance as well as tonnage is the ton-mile. Differences in output corresponding to the various equipment usage, segment usage, and travel times are directly reduced to cost and benefit differences. Consequently, the "ton-mile" is selected as the most appropriate unit for universal measurement of system output.

The objective of systems analysis is to minimize time per unit of output, where ton-miles are used to measure output. The functional relationship between time and output has its origin in queuing theory since locks tend to

pose a first constraint to output. Figure 1 presents the general form of this curve for a single structure. For a given aggregate demand component, say for all tonnage between points A and B, the relationship between time and output could be constructed by adding such curves vertically for each structure located between A and B, and by adding curves representing pool constraints between A and B. The result would be a composite time-output relationship for that specific demand. Some of these same curves would also enter into the composite relationships for other demands as well (say from point A to point B).

The system has been constructed, is maintained and is operated by the Federal Government. Since shippers do not pay all of the system costs, an externality results which tends to produce a long-run equilibrium traffic level which exceeds the optimum. The magnitude of the externality and the divergence between equilibrium and optimum levels is a direct function of system output in relation to system capacity. Shippers pay only their average costs for system use, not their true marginal costs. Consequently, in the long-run, shippers will choose the level of output which equates average system towing costs and demand, not marginal system costs and demand.

The standard textbook approach to the problem of waterway systems economic analysis involves application of supply-demand analysis and optimization techniques. A single private firm would attempt to maximize profits by attempting to operate at the point of intersection of marginal costs with marginal revenues. Since the objective of public investment is to maximize social welfare, two production levels are of importance. Optimum production would occur at the intersection of the marginal cost curve with the average revenue, or demand curve. However, in the longrun (in the absence of institutional restraints) equilibrium production would occur at a level of output which exceeds the optimum.

Proper definition of costs poses another series of options. Benefits (cost-savings) for waterway transportation arise through the interaction of overland carriers, waterway carriers, terminal operators, shippers, and Federal

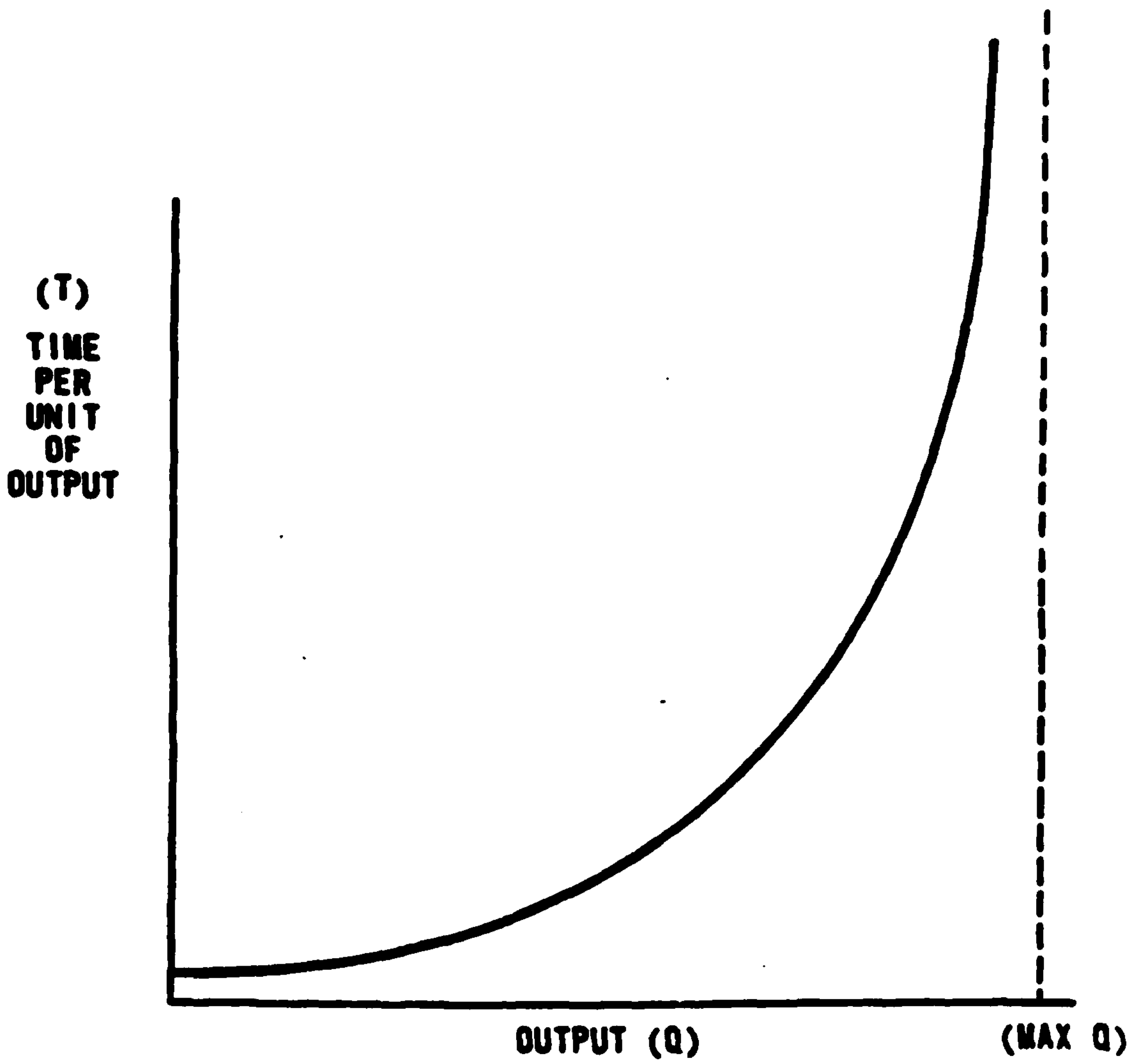

FIGURE 1
LOCK SERVICE TIME VS. LOCK THROUGHPUT

waterway system maintenance and operation. However, only those costs which are deterministic to waterway traffic levels should be included in the model analysis. These would include costs for all activities within the waterway operator's production function as well as assessorial charges and costs for overland linkages. These are the costs which eventually must be borne by the shipper, who makes the decisions regarding transportation demands. Federal costs for system maintenance and operation are included only to the extent that they are internalized in the waterway operator's production function.

Definition of system benefits poses no problem. The benefit is the waterway economic advantage over the least-cost alternative routing. This economic advantage is denoted as rate savings, but also accounts for any differences in charges incurred for traffic arising from loading, unloading, and other activities not water-related. It is the total savings to the nation per unit of output for providing and maintaining the waterway system.

System definition presents another array of possibilities. The interrelationships between two or three locks and dam projects within a system can be easily identified. However, a large system containing many individual projects becomes much more complicated. Actions taken at one project can theoretically affect a project hundreds of miles away, even if there exists no common traffic. This relationship occurs because each of the projects may have separate traffic components which are both common to a third structure somewhere in the system. In actuality, the conditions under which such an effect could occur are rather restrictive, and for purposes of this study, projects in the system having traffic common to the BWT are of much more concern.

The demand schedule is a downward sloping schedule of aggregate waterway traffic demands. It should be noted that the traffic demands are bounded by some maximum output level for the system because of project constraints. Second, the waterway towing industry is not bound by the principles of welfare economics, but is comprised of a number of individual firms, each attempting to

maximize profits individually. Third, the consumers of wateray transportation services are also attempting to maximize profits. Consequently, it is likely that actual traffic levels (output) will differ from the social optimum. Over time the horizon of changing aggregate transportation demand schedules, the questions to be answered by the model for each configuration of the system are:

a. What volume of traffic will shippers and carriers chose to move on the waterway system, given each shipper's own unique set of economic and noneconomic variables?

b. Given this same set of variables, what volumes of traffic will these shippers divert to alternative modes, ship to other destinations or move over other routes?

c. What are the origin, destination, and commodity characteristics of the traffic diverted, rerouted or shifted by the shippers, given the same set of economic and noneconomic variables?

d. What are the national transportation cost savings (or dis-savings) associated with the decisions above?

e. For the optimum level of traffic on the waterway, what volumes of traffic would be diverted to alternative modes of transport, shifted to new origins and destinations or rerouted on the waterway?

f. What are the origin, destination, and commodity characteristics of the tonnages diverted, rerouted or shifted, given optimum waterway traffic levels?

g. For the optimum waterway traffic levels, what are the transportation cost savings (or dis-savings) to the nation?

To answer these questions, one must analyse the effect a system change has on each and every potential commodity movement. For each potential movement,

the transportation charge is determined for a given system configuration and loading. The charges are compared with charges for the least-cost alternative routing, and system rate savings (or dis-savings) are computed. The movements are then ranked from highest to lowest rate savings. For this ranking, accumulated system traffic, accumulated system rate savings, and accumulated shipping cost are tabulated as running totals to correspond with each potential movement. Marginal costs can be computed by dividing incremental differences in accumulated waterway routing transport charges by incremental differences in accumulated traffic.

Four system production levels are important. For either practical or theoretical reasons, these levels of production are equally important. First is the production level at which maximum net system rate savings are attained (MTC and ARS). This is the point of social optimum waterway use.

The second level is the longrun equilibrium level of traffic which would result in the absence of any institutional restrictions. At this level there are traffic movements which exhibit marginal towing costs in excess of average rate savings. However, since each shipper pays only the ATC, these "marginal" movements would continue to use the waterway system. This is the level used for benefit measurement on Oliver Lock.

The third level reflects a level of traffic beyond the equilibrium level. At this level there are traffic movements which exhibit negative average rate savings (ATC-ARS). This point of system production is significant since it is observed that traffic having such characteristics actually occur on the waterway.

The reason for existence of negative-savings waterway movements include:

-Imperfect knowledge by shippers of available transportation options.

-Market prerequisites and inertia, including the effects of long-term coal-transport agreements.

-Firms just entering or leaving the market, or in the process of shifting between transporation modes.

-Emergency shipments.

-Provisions for future flexibility in transport modes, as in the electrical industry, to assure production certainty.

-Overland transport equipment shortages.

-Potential problems in WCSC commodity classifications.

-Imperfect rate analysis for oversized shipments.

-Failures in overland rate negotiations.

The remaining production level is included primarily for reference. This level represents the output level corresponding to maximum system capacity. Because of the nature of the cost curve, this production level would likely never occur over a sustained period of time if it is known that system capacity would never change.

Ordinarily, the remaining task would simply involve selection of the optimization criteria, determination of the proper intersects and identifiying the output aggregates on either side of the intersects. However, the nature of the waterway system is such that individual increments of output influence the costs of other output increments. Therefore, each of the critical points must be determined through incremental diversions of traffic from the waterway and the reiteration of the entire modeling process. The diversion analysis will be discussed later.

For each iteration, i.e., each traffic level, the model should output the total net system rate savings. This traffic level and associated benefits represent the results of evaluation of one point in time and one system definition. By varying time and system definition independently and repeating the analysis, the ability of any system definition to accommodate projected traffic demands can be determined. Incremental differences between aggregate traffic levels and corresponding system benefits over time are attributable to the changes in system configuration. If the change in system definition involves only a single lock and dam structure, then the incremental differences are assignable to changes at the single structure.

Application of this conceptual model three sequential steps. First, an approximation of the demand schedule for each point in time must be developed

external to the model. Secondly, an approximation of transportation rate savings afforded by the system must be available. Finally, the capability to evaluate the effects of aggregate system traffic levels on the rate structure for each individual traffic movement must be available. These topics are highlighted in the following paragraphs.

DEMAND PROJECTIONS

For application of the conceptual model, traffic demand input must not be constrained by the existing system definition. System constraints can be embedded in the model itself in the form of interrelationships among aggregate system traffic, system physical capacity, and costs for individual movements. Consequently, initial model shipment inputs should include projected levels of potential traffic which assume that any existing and potential system bottlenecks will be eliminated. Application of the model itself will then constrain traffic only to those levels which may realistically occur, given the specified system definition, the origin-destination and commodity mix of demands, and the relationship between waterway charges and least-cost alternative charges.

The development of unconstrained traffic demand projections pose several problems, depending on the method of projection. Statistical analysis of historical flows and correlation with controlling economic parameters can result in projects which exhibit waterway constraints if a portion of the historical period exhibited such constraints. Use of shipper survey techniques to determine the future plans of individual waterway users can also result in projections which reflect system bottlenecks; some waterway users may consider such constraints in planning future transportation strategies, while others may not have a clear understanding of the relationships between such constraints and internal shipping costs. Likewise, market analyses and modal-split investigations can reflect transportation system constraints if the historical patterns of production and shipment have been influenced by constraints. Even the use of inter-regional, input-output analysis techniques are subject to the same problems since historical data must be used to construct the initial quantitative relationships among economic sectors and regions.

The later section "Model Application - Shipment List" provides a full explanation of procedures and assumptions used. In short, two traffic demand projection sets were used in this study. The first was based on the OBERS 1980 projections and was applied to the 1979 WCSC commodity movement data. The second set of projections used were developed by A. T. Kearney for the TTW traffic.

RATE ESTIMATES

The Corps maintains a full record of individual dock-to-dock traffic movements through data maintained by the WCSC. Within the WCSC system, commodities are uniquely classified using a detailed 4-digit code.

Because of the many thousands of individual movements which occur on the inland waterway system in any single year, it is neither feasible nor practical to model individual dock-to-dock shipments. Even after consolidating shipments to annual movements between a pair of docks, about 143,155 such movements of 4-digit commodities occurred on the system defined for this study in 1979. For modeling purposes, the number must be condensed considerably. Consequently, commodity groupings were consolidated into 15 aggregations, and docks consolidated to "port equivalents." In this way, the number of origin-destination commodity cells in the traffic matrix is substantially reduced to about 1,387. Rate data must also reflect this level of aggregation.

Rate studies were initiated with the compilation of data for movements on the BWT and projected rates for the TTW. Rate data collected by the Ohio River Division for use in the Gallioplis and Lower Ohio River studies were used for the traffic that utilized the Ohio River. Rate data gathered by the St. Louis District for the traffic using the IHNC that did not use the BWT served as the basis for this additional traffic. Each cell in the resultant matrix contains charges per ton for waterway linehaul activities, charges per ton for all activities associated with the waterway routing, and the total charges per ton for the least cost alternate waterway or overland routing, whichever applied.

The rate matrices initially developed were for different years and were subsequently updated to October 1981 price levels. Since actual rates being charged by carriers were used to develop the matrix, it reflects the waterway system definition and aggregrate system traffic levels existing at the time that base data were being collected. Since the many waterway shippers could not possibly know what rate levels would be appropriate under conditions of different aggregate traffic levels or system definitions, waterway costing methods must be used to determine such rates. Pursuant to guidance provided by the Water Resource Council, rates for alternative least-cost overland modes are generally assumed to remain unchanged.

WATERWAY SERVICE COST ANALYSIS

As stated previously, unit waterway costs vary considerably from one movement to another. If a waterway operator were bidding on a transportation contract, his analysis would consider many factors relevant to the individual movement, as well as to his own equipment availablity and the possibility of obtaining backhauls. Transit times would entail the accumulation of the component times. Times required for lock service would simply represent "givens" in his formula which would be derived from operational experiences. In short, the analysis would represent a static situation where any influences on his costs due to aggregate traffic levels and system capacity would be internalized indirectly by keeping records of recent operations. Such an analysis fails to quantitatively recognize the parameters pertinent to this study.

The ability to internalize system capacity and aggregate industry operations has been limited historically because of the vast number of computational requirements. With the development of computer languages which provide efficient matrix computation and data storage has come several waterway-costing computer models. They vary in level of detail, in the handling of transit time computations, as well as in the maximum size of the system handled.

The models selected for this study were a combination of the TCM and a revised WAM. This allows the use of an overall system costing model that can

size the fleet for changing conditions on the waterway system and a simulation model that allows the determination of the effects of locks and other waterway constraints the traffic, in particular increased service and delay times. These models are be discussed further below.

TCM/WAM COST OUTPUT VS. TRANSPORT RATES

The conceptual model assumes that any changes in waterway transportation costs which result from changes either in aggregate traffic levels or in system specifications would induce a corresponding proportional change in waterway linehaul rates. For example, if TCM/WAM output showed that for a specific movement waterway linehaul costs increased by 20 percent when aggregate traffic increased from 180 to 230 million tons, then the rate charged the shipper would also increase 20 percent.

Theoretically, it should be possible to use the TCM/WAM to very nearly replicate the waterway linehaul rates determined from transportation rate surveys. This is possible by using the aggregate traffic levels that actually were occurring at the time of the rate study as inputs, and defining the system under conditions that existed at the time of the studies. In actuality, this can never be done precisely. Too many assumptions must be made in the analysis, and there exist too many unknowns regarding specific procedures the many waterway operators use to establish operating patterns. Waterway operators are competitors whereas the TCM/WAM optimizes as if the industry were a single monopoly. The TCM/WAM assumes perfect knowledge of all factors affecting costs; all waterway operators are not afforded prior perfect knowledge of the cost items which will face them. Also, the overall analysis assumes that the results are insensitive to the aggregation of individual movements to model port-to-port commodity groupings.

Accepting the fact that modeled costs will never correspond on a movement-by-movement basis with actual rates being charged shippers, procedures have been developed which assume that incremental changes in modeled costs will be reflected on a proportional basis in the rates. The procedures form the basis

of a supplementary computer routine known as the "Marginal Economic Analysis Post-Processor." In the development of this routine, it was recognized that total waterway transport charges could not be adjusted in direct proportion to differences in modeled waterway linehaul costs. Consequently, the base rate matrix developed for use in this analysis shows waterway linehaul rates as a separable component of the total routing charge. For any future TCM/WAM run, movement-specific costs are compared with the costs which correspond to the base-condition model run; the percentage change is applied to the base waterway linehaul rate; and the nonlinehaul charges (unchanged) are added to the revised linehaul rate to obtain the new total waterway routing charge.

No adjustments are made in the conceptual model to either the nonlinehaul water routing charges or the least-cost overland routing charges. The changes made in the water linehaul rates are adjustments which reflect increases or decreases in transit time and optimum tow configurations attributable to either a change in aggregate traffic volumes or a change in the physical system itself.

MARGINAL ECONOMIC ANALYSIS

The theoretical application of marginal economic analysis generally involves smooth, uniform, and marginal cost of benefit curves. However, real-world economics are not often that simple. Use of the ton-mile as the unit of measure for system output to some extent standardizes the view of production throughout the system. Even with this standardization, some variability remains in the characteristics of output.

To a great extent, the waterway system produces for a differentiated market. In other words, the aggregate demand for waterway system output is really a collection of many demands, each slightly different from the others. Variations arise due to differences in the commodities shipped, costs of production throughout the system, and characteristics in the rate structure for least-cost overland or alternate waterway routings.

As a result of differentiation in output, relationships between marginal costs and rate savings at alternative levels of output are somewhat erratic. In marginal analysis, incremental outputs (which occur in uneven quantities corresponding to movement size) are ranked in such a fashion as to form the smooth benefit curve. Waterway linehaul rates may tend toward a smooth curve, but marginal total waterway routing charges (marginal costs) will be less inclined to represent a smooth trend. However, since the MEA analysis relies on the average and marginal rate savings, the unevenness of the marginal cost curve is not significant.

Marginal economic analysis applications in this study are basically two-fold. The first application is used to determine the aggregate level of traffic that will move on the system and through the BWT study area for each of the three relevant system production levels. Having arrived at these answers, the individual movements remaining on the waterway and those diverted to an alternative route or mode can be identified. This process is repeated for each year of traffic demand projections and for the with and without conditions. For this study, structural remedies are contemplated only for the Oliver Lock with operational improvements at Demopolis and Coffeeville Locks. Pickwick Lock is improved with the 1,000 ft by 110 ft lock chamber that is currently under construction for the future years. Nonstructural measures were considered at the Oliver Lock; however, it was found that the capacity could not be increased significantly. The nonstructural measures primarily included the construction of mooring cells to improve the double locking procedure. The use of mooring cells approximated the ready-to-serve option. These conditions were used for all future without project tests.

The second application of marginal analysis is the determination of incremental benefits for the replacement plan. For the selected plan, accumulated traffic levels and incremental benefits and costs are computed for each year. Costs associated with each alternative represent the Federal costs for construction and operation and maintenance. Average annual benefits and average annual costs are estimated to determine economic feasibility.

In the first analysis, the objective was to determine traffic levels. Only those costs incurred by the waterway shippers are deterministic in this decisionmaking process. Shippers use only those rates and charges which are internal to their production function to compute costs and determine the extent of waterway usage. Therefore, only those portions of waterway facility costs which have been passed on the them by the towing industry are internalized.

In the second analysis (see main body of report), objectives are to determine the nature and timing of Federal investment. Costs pertinent to these decisions are those borne by the Federal Government in making such investments. If portions of these costs are passed on the ultimate waterway shippers through user charges and subsequent increases in waterway freight rates, then the benefits credited to each alternative have been reduced by an equal amount. In effect, this represents a transfer payment and consequently, benefits must be adjusted upward to offset this effect.

APPENDIX B

ATTACHMENT 3

MODELING SYSTEM DESCRIPTION

EXISTING MODELS

INSA MODELS

The original INSA package, developed in 1974-1975 by the Office, Chief of Engineers (OCE), was a planning capability comprising an integrated system of computer models, data, and planning procedures. The INSA system of models was designed to replicate on a day-to-day basis the national market system and the role of inland waterway transportation within that system.

Within INSA, one pair of models, consisting of the Commodity Flow and the Multimodal Models, simulated the national market system and the complete national transportation system. The Multimodal Model was designed, for example, to model shipments over waterways, railroads, highways, pipelines, and even electrical transmission systems. A second pair of the models, consisting of the Flotilla and Navigation Simulation Models, simulated inland waterway transportation in detail. More complete information on these four models is available in the INSA documentation of these models.

Since 1975, extensive testing of these models has been carried on by the OCE, the Ohio River Division, by various local Corps Districts, and by a number of other Federal, state, and private planning organizations. As a result of this testing, the first two of these models, the Commodity Flow and Multimodal models, are no longer used by the Corps for systems analysis purposes. This is due both to the complexities of data requirements for these models, and difficulties in validating the model's logic.

MODIFICATIONS TO INSA MODELS

Considerable work has been accomplished, however, with the Flotilla and Navigation Simulation models, particularly in the Ohio River Division.

Extensive testing of the Simulation Model was undertaken by the Pittsburgh District, and several modifications to this model were made with the help of CACI, Inc., and other private consultants. Primarily these corrected and improved the model's logic and improved the simulation of locking procedures. The updated version of the model is known as the Waterway Analysis Model (WAM).

Perhaps the most significant result of ORD coordination since 1974 has been the development of the Tow Cost Model (TCM), as well as various supplemental computer programs such as the Marginal Economic Analysis (MEA) postprocessor. The TCM is an extensive upgrading of the original Flotilla model. This model allows for a thorough economic analysis of overall system impacts arising from individual improvements at any point in the system. The model is most applicable for analysis of navigation elements which are heavily dependent on maintenance of locks and dams, but requires good estimates of lock capacities and traffic-delay relationships as input. Huntington District has been primarily responsible for upgrading and verification of the TCM, and for development of the MEA procedures. Louisville District concentrated on review and development of methodologies for estimating lock capacities and traffic-delay relationships.

SHORTCOMINGS OF EXISTING MODELS FOR PRESENT STUDY

While these models have been used sucessfully in several major studies, there were several shortcomings that created limitations in the usefulness of the models. One of the limitations in all of the systems analysis models that have been created and used by the COE has been the inability to model accurately the impacts of constrained channels. The BWT is a narrow waterway with many sharp bends wherein traffic is restricted to one-way operations. Therefore, one of the important considerations of this study was the impact these bend constraints have on the capacity and costs of operation. Two important factors have to be included;

1. the delay caused by the one-way restriction and
2. the reduced transit speeds required by the difficult maneuvering conditions.

Studies performed in the 1970's indicated that the bends on the BWT before Demopolis, Alabama, could prove to be a major constraint. However, these earlier studies were based on the following parameters:

- o 300' waterway
- o dual 110' by 600' lock chambers at Coffeeville and Demopolis
- o two-way eight-barge tow traffic

Such is not the cause of the present study, which is based on the existing project dimensions below Demopolis, Alabama.

It is felt that the best way to analyze these impacts is with a simulation model study to address the potential delays at the bends.

Another limitation of the WAM was the extreme detail included in the model. The WAM was developed to emulate the complete operation of the entire waterway system including all of the dispatching and operational decisions made by waterway operators. This excess of detail creates extremely high operating costs. In addition, the use of this model in comparative analyses is limited due to the nature in which the tow movements are generated. Therefore, it is difficult to interpret the results of similar commodity movement levels under different waterway conditions.

In order to use the TCM, a method for determining the physical capacity of the locks and the delay-lock utilization relationship is required for each lock. Presently there are two accepted methods for accomplishing this. One is to use a simulation model such as WAM; the other is to use an analytical approach, such as LOCALC or LOKCAP. The limitations for using WAM have just been discussed. LOCALC and LOKCAP both require a fixed description of the commodity mix, the commodity-barge relationship, the tow-size distribution and the chamber assignments for lockages. While reasonable estimates of the lock physical capacity are possible under the stated conditions, as future traffic projections are analyzed these conditions change and, when using the TCM and MEA method of analysis, they change as the marginal traffic is eliminated in order to obtain new estimates of the operating costs and rates within a given future condition. Futhermore, the delay curve estimates are based on a very

simplified queuing theory relationship that is quantified through empirical data. As conditions deviate from that empirical data the derived relationship's validity becomes questionable. If the empirical data does not include an adequate range of utilization levels, particularly in the 70 to 99 percent utilization range, the validity of the empirical relation at the most critical levels of use will not be adequately represented.

SYSTEM SELECTED FOR THIS STUDY

The requirements of this study and the limitations of the available models discussed above, dictated that an improved and expanded modeling system be developed in order to study the BWT improvements. An earlier study of the Lower BWT below Demopolis Lock and Dam had indicated that a large number of bends would require widening and/or the development of cutoffs to overcome anticipated constraints on that section of the BWT. Therefore, a detailed analysis of the impacts of bendway constraints on the economics of the navigation traffic was necessary.

It was decided that the best approach would be to modify and generalize the available modeling and economic analysis system that had been developed and tested over the past seven years. The TCM system provided the basic means for determining the resulting costs of waterborne commodity movements under various conditions and waterway systems. The MEA provided the method for determining the benefits in terms of rate savings and traffic that is marginally uneconomical under the tested operating conditions. Finally, WAM could provide the base for simulating the capacities and delays at locks and the transit and delay times at bends under each operating condition.

The general outline of the system used in this study will be described below. First, because both the TCM and the WAM required almost identical data although in different formats, a Preprocessor Program was developed that would allow a single set of data to be developed that would describe the waterway and operating conditions. This preprocessor would then generate the data required for both programs in the proper format.

The WAM model was modified extensively. First it was modified to eliminate the simulation of the total dispatching and equipment operation. Instead it would accept externally generated shipments assigned to preconfigured tows. These tow shipments would arrive in the system at randomly designated times at assigned ports and destined to specified ports. These shipments would be generated from the Resource Requirements File generated by the TCM. In addition WAM was modified to enable the simulation of operations at a bend. Finally, the WAM output was expanded to include the results of the bend simulation and information for the Resource Requirements File. This data would be incorporated into the Resource Requirements File produced by the TCM and used in the MEA.

TOW COST MODEL-ANNUAL VERSION

The TCM consists of two programs, the Resource Requirements Program and the Resource Requirements Program Postprocessor. The Resource Requirements program determines the least-cost set of towing equipment for use on the system, based upon a given set of annual origin-destination commodity flows and system configuration and specifications. Calculations of direct costs borne by shippers are made. Capabilities exist in the program for the specification of any level of user charges. Output from the Resource Requirements Program is denoted as the Resource Usage File (RUF). Dicussions of the detailed operations performed by the program are described in the model documentation and in Appendix N, General Design Memorandum Gallipolis Locks and Dam Replacement.

The RUF serves two purposes. First, it provides the definition of tow movements required to transport the commodities between the origin and destination points and the optimum size tow to perform those movements for use in generating the tow movement list required by the WAM. Second, it is the source of tow movement characteristics and operational timings used to generate the transportation costs used in the MEA. This file is input to the Resource Requirements Program Postprocessor which generates a series of individual Trip Reports which contain detailed carrier cost data. Output is to a computer file with user option for selected hardcopy outputs. The user also controls the

selection of origin-destination pairs for which Trip Reports are desired. As used in this study, data from the Trip Report File represent input to the Marginal Economic Analysis Postprocessor which has developed by the Huntington District. The Marginal Analysis Postprocessor as well as routines developed to access the Trip Report File will be discussed subsequently.

MODIFIED WATERWAY ANALYSIS MODEL

The WAM is a model of waterway operations that simulates the events or activities that take place as a tow moves from the point of origin to the destination of a commodity movement. Statistics are recorded on the details of these movement events for printed reports and for output data files.

As originally designed, WAM involved detailed simulation of the loading and unloading of barges, the location and transportation of empty barges to the ports needing extra barges, the location of available towboats required to push the tow and all the attendant record keeping necessary to manage the fleet. For purposes of this study, these functions were removed and replaced by an external event list that contained a full description of the tow movements required to transport the commodities expected to be moved during the simulation period. This list includes the tow type, barge type, transportation class, tonnage, origin port, destination port, number of empty and loaded barges, and the time of entry into the simulation.

The external event list is generated from the RUF created by the TCM. The RUF identifies the number of round trips, the towboat class, barge type and tow size selected, the barge load allowed, and the empty backhaul factor for each segment of a transportation class movement. A movement scheduling program was written that schedules each tow movement that would likely take place during the simulation period to be tested. If a movement is refleeted, each segment of the movement is scheduled based on the RUF description of those segments. Backhaul potential for each segment is taken into account.

A method for modeling the transit of tows through restricted bends on channels was added to the WAM model. In addition to defining reaches through

which tows travel, a bend may now be defined. Upon arrival at a bend, the simulation model will determine if another tow is in the bend or if a downbound tow is about to enter the bend. If the bend is not in use, the tow is allowed to enter that reach of the system. If the bend is occupied or is about to be occupied, the model must then determine if the tow approaching the bend can enter, i.e., are the channel and tow sizes such that two-way traffic is allowed. The channel width required by both tows is determined from the design curves contained in the Engineering Manual 1110-2-1611, Layout and Design of Shallow-draft Waterways dated 31 December 1980. For purposes of this study the curves for 90 degree central angles and 6 fps velocities were used since most bends were long and the velocities at high discharge rates are around this speed. If the required width is greater than the width of the channel, then the upbound tow is required to wait in queue until the channel is clear and the delay is recorded.

The reports generated by the WAM were expanded to include a report that describes the activities at the bends. In addition, a new data file can be generated by the WAM that contains a description of the time spent in transit, lockage, delay at locks, transiting bends, delay at bends, and in loading and unloading operations. This data file can then be processed through a utility program that groups the individual tow trip reports for the same movement segment and creates a WAM RUF for use by the Resource Requirements Program Postprosessor.

MARGINAL ECONOMIC ANALYSIS PROGRAM

The Marginal Economic Analysis (MEA) program used is basically the one developed by the Huntington District. The procedure is designed to provide a general approach for use in developing marginal cost and benefit relationships for waterway systems analysis. The MEA program uses costs developed from the measures of loading and unloading, transit, locking, and delay times as developed by the TCM or as modified by the WAM. Costs are applied to each of these measures independently for each movement segment for either the base or future condition being tested. As the delays increase with escalating traffic levels or the system efficiency is improved when the system is modified, the

base rate as determined in the rate survey is modified to reflect the charges in line-haul costs. The MEA displays the transportation class movements ranked in order of decreasing marginal rate savings in order to aid in the diversion of traffic from the system. In addition, the MEA displays traffic, cost, and rate savings data for movements common to specific reaches of the system as designated by the user. In this particular study, this information was displayed for the total BWT system, as well as Oliver, Coffeeville, and Demopolis Locks.

A more detailed description of the MEA program is presented in Appendix N, General Design Memorandum, Gallipolis Lock and Dam Replacement. This reference describes the program logic in detail. Two changes were made for purposes of this study. The first was to modify the code so that reports for the BWT system would be generated. The second modification actually was made in the Resource Requirements Program Postprocessor. Since the WAM was generating a RUF which included delay times at bends and was generating delays at locks based on simulated queuing events which were believed to give a more realistic measure of the delays than the queuing theory curve used by the TCM, those movement segments that had records generated by the WAM in the RUF had the times for transit, locking and delay times from the WAM model substituted into the TCM RUF before being processed by the MEA. The transit time included the transit times for regular reaches and bends and the delay times included the delays recorded for locks and bends.

MOVEMENT DIVERSION

When the capacity of a lock is exceeded, delays at the lock become excessive and the costs of operation escalate rapidly. Movements of commodities on the waterway will be diverted to alternate modes of movement, particularly the movements that have negative rate savings. When the capacity of a lock was exceeded as identified in the WAM results, traffic had to be removed in order to complete the simulation runs. Therefore, a procedure developed by the Huntington District was used to divert traffic from the waterway.

This procedure uses the list of traffic movements ranked by rate savings created by the MEA program. This list is searched beginning with the largest negative savings movement. As each lock is located that has been identified as having excess tonnage using the lock, that movement is flagged. If a movement uses more than one lock that has too much traffic, that movement is marked for each lock. This continues until the tonnage requested to be removed from the locks is identified. Those movements involving more than one lock are removed first. Then the remaining tonnage is removed from the shipment list in order of decreasing negative rate savings. If the last shipment removed for a lock is larger than the tonnage required to satisfy the request, only that portion required to reduce the tonnage to the desired level will be removed.

APPENDIX B

Attachment 4

Data Tables - Model Applications

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
3	68	5	0.0	7	15	17	19	23	24
4	39	12	0.0	9	13	15	16	19	27
4	49	5	0.0	4	8	9	10	13	19
4	61	12	0.0	13	17	19	21	25	35
4	65	12	0.0	6	9	10	10	13	18
4	73	12	0.0	9	12	13	14	17	24
4	75	12	0.0	10	13	14	16	19	27
4	88	12	0.0	8	10	11	13	15	21
5	47	5	0.0	13	27	30	34	41	60
5	88	10	100.0	22	28	31	33	38	53
6	41	4	0.0	36	64	78	94	124	214
6	44	12	0.0	27	36	40	43	52	73
6	45	9	100.0	14	18	20	21	25	34
6	47	5	0.0	8	18	20	22	27	40
6	51	4	0.0	31	45	53	62	81	135
6	51	10	100.0	11	14	16	17	20	27
6	68	10	100.0	10	13	14	15	18	24
6	68	12	0.0	31	42	46	50	60	85
6	69	12	0.0	21	29	32	36	42	60
6	73	9	100.0	9	12	13	14	16	22
6	75	12	0.0	182	244	266	291	347	490
6	75	14	0.0	5	7	8	9	11	15
6	77	12	0.0	76	101	112	124	147	207
6	88	10	100.0	12	14	16	17	20	28
6	88	12	0.0	102	136	149	163	194	276
6	93	12	0.0	9	12	13	15	18	25
6	102	12	0.0	1	16	18	21	28	44
7	44	12	0.0	8	10	12	13	15	22
7	45	9	100.0	13	17	18	19	23	31
7	74	9	100.0	6	7	9	9	10	15
7	75	10	100.0	7	9	10	11	13	18
7	88	10	100.0	11	14	15	15	19	26
7	93	10	100.0	25	34	35	39	45	62
7	93	14	0.0	26	35	38	42	50	71
8	51	4	0.0	33	49	57	68	87	146
8	65	7	0.0	9	12	13	14	16	22
9	39	12	0.0	6	8	8	9	11	16
9	51	4	0.0	5	8	10	11	15	25
9	64	12	0.0	5	7	8	9	11	15
9	68	12	0.0	5	7	8	9	11	15

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
9	74	4	0.0	16	48	62	80	108	196
9	74	9	100.0	11	13	15	16	18	26
9	88	10	100.0	9	12	12	14	16	22
10	39	12	0.0	22	30	33	36	44	62
10	43	12	0.0	31	40	44	49	58	83
10	45	9	100.0	8	11	11	12	14	20
10	47	12	0.0	16	21	23	26	31	43
10	59	12	0.0	14	19	22	24	28	41
10	62	12	0.0	9	13	14	15	18	26
10	65	10	100.0	10	12	13	14	17	23
10	68	12	0.0	28	38	42	46	55	78
10	69	12	0.0	45	60	65	71	85	120
10	72	12	0.0	8	10	12	13	16	22
10	73	12	0.0	29	39	43	46	55	78
10	75	12	0.0	128	172	188	204	242	346
10	75	14	0.0	6	8	8	9	11	16
10	77	12	0.0	78	105	115	125	151	213
10	88	12	0.0	36	50	54	59	71	101
10	88	14	0.0	5	7	9	10	11	16
10	93	12	0.0	9	12	13	14	17	24
10	93	14	0.0	7	10	11	13	15	22
11	45	9	100.0	6	8	9	9	11	15
11	65	9	100.0	12	15	17	18	21	29
11	68	9	100.0	6	8	9	9	11	15
11	74	9	100.0	71	91	98	104	123	168
11	75	9	100.0	30	38	40	43	50	69
11	88	10	100.0	8	10	11	11	14	20
12	41	4	0.0	14	27	33	40	53	93
12	41	12	0.0	6	9	10	11	14	22
12	51	4	0.0	69	101	119	140	180	302
12	56	5	0.0	11	26	30	34	40	60
12	68	5	0.0	8	16	19	21	26	39
12	72	10	100.0	5	8	9	10	13	20
12	73	9	100.0	5	8	8	9	12	18
12	75	11	0.0	3	9	11	14	20	36
12	93	10	100.0	5	7	8	9	11	16
13	39	12	0.0	33	48	53	60	74	113
13	43	12	0.0	16	22	26	29	35	54
13	54	12	0.0	23	34	37	41	51	80
13	59	12	0.0	47	65	76	84	105	160

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
13	65	12	0.0	163	231	259	291	358	543
13	68	9	100.0	7	9	12	13	17	25
13	68	12	0.0	63	88	99	112	134	209
13	69	12	0.0	13	20	22	26	32	49
13	73	9	100.0	20	28	32	36	45	69
13	75	12	0.0	48	68	76	86	106	160
13	76	12	0.0	15	22	24	28	34	53
13	88	10	100.0	12	18	20	22	28	44
13	88	12	0.0	38	53	61	68	84	129
13	93	10	100.0	11	16	18	21	26	40
14	39	12	0.0	7	9	11	12	15	23
14	47	5	0.0	716	1498	1690	1905	2348	3566
14	49	5	0.0	1794	3755	4236	4776	5885	8937
14	54	12	0.0	12	17	19	21	27	42
14	64	12	0.0	6	9	10	11	14	22
14	65	12	0.0	18	25	28	32	39	60
14	68	5	0.0	4	9	10	12	15	22
14	68	12	0.0	20	29	33	37	45	69
14	69	12	0.0	10	14	16	18	22	33
14	95	12	0.0	1	20	23	27	35	58
15	73	10	100.0	16	23	27	30	38	59
16	40	6	0.0	6	10	12	13	16	24
16	50	6	0.0	18	30	33	37	45	67
16	59	12	0.0	11	17	19	21	26	40
18	49	5	0.0	83	201	227	257	315	555
18	53	5	0.0	84	203	230	260	319	562
18	88	5	0.0	66	161	183	207	253	446
19	45	5	0.0	5	12	14	16	20	35
19	88	5	0.0	13	32	36	41	50	88
20	54	9	100.0	7	10	12	14	18	28
20	59	9	100.0	76	108	124	141	175	272
20	61	9	100.0	17	25	28	32	40	63
20	63	9	100.0	5	8	9	10	12	20
20	75	9	100.0	47	67	77	87	109	170
20	82	9	100.0	1	21	24	28	36	60
20	88	5	0.0	5	12	14	16	19	35
20	91	9	100.0	15	22	25	29	36	56
21	68	5	0.0	4	9	11	13	16	27
22	47	5	0.0	73	162	189	219	279	450
22	57	5	0.0	13	29	34	40	51	82

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
23	39	10	100.0	12	21	25	29	36	58
23	40	5	0.0	19	44	51	59	76	122
23	40	10	100.0	9	16	19	22	27	44
23	41	10	100.0	8	14	17	20	25	39
23	43	10	100.0	48	83	97	113	142	223
23	44	5	0.0	304	679	789	916	1164	1882
23	45	5	0.0	685	1525	1773	2059	2618	4230
23	45	9	100.0	4	8	9	11	14	22
23	47	5	0.0	25	57	66	77	98	159
23	52	11	0.0	19	29	34	40	51	86
23	53	5	0.0	884	1966	2284	2654	3372	5448
23	54	5	0.0	17	39	45	52	67	109
23	54	10	100.0	6	11	12	14	18	29
23	54	12	0.0	6	11	13	14	18	30
23	56	5	0.0	14	31	37	43	54	89
23	57	5	0.0	13	29	34	40	51	82
23	59	5	0.0	28	63	74	86	109	177
23	63	12	0.0	10	17	20	23	29	47
23	65	5	0.0	225	502	584	678	861	1393
23	65	10	100.0	50	87	101	118	148	234
23	65	11	0.0	6	9	10	11	14	21
23	65	12	0.0	5	8	9	11	14	22
23	66	5	0.0	745	1658	1926	2237	2844	4594
23	67	10	100.0	5	8	10	12	15	23
23	68	5	0.0	3	9	10	12	16	27
23	68	12	0.0	8	12	14	17	21	35
23	69	12	0.0	4	8	9	11	14	23
23	73	9	100.0	23	39	46	53	68	107
23	73	10	100.0	14	24	28	32	40	64
23	75	5	0.0	376	840	977	1134	1443	2332
23	75	9	100.0	16	26	32	37	47	73
23	75	12	0.0	19	29	34	40	50	81
23	76	9	100.0	10	18	22	26	32	51
23	76	10	100.0	12	21	25	29	36	58
23	77	9	100.0	10	18	21	25	31	49
23	88	5	0.0	16	38	44	53	67	108
23	88	9	100.0	18	31	36	42	54	86
23	88	10	100.0	39	69	81	94	119	189
23	88	12	0.0	5	8	9	11	14	23
23	91	5	0.0	72	162	188	219	279	452

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
23	93	10	100.0	32	54	63	73	92	143
24	39	10	100.0	75	129	150	175	220	347
24	40	10	100.0	15	26	30	35	44	70
24	43	10	100.0	37	63	74	87	109	171
24	44	5	0.0	61	135	157	183	233	376
24	44	10	100.0	15	27	31	37	46	74
24	45	5	0.0	120	274	316	365	459	761
24	45	10	100.0	10	18	21	25	31	50
24	47	5	0.0	9	21	25	28	34	61
24	53	5	0.0	413	999	1131	1282	1570	2760
24	59	5	0.0	79	176	205	238	303	490
24	59	10	100.0	23	39	46	54	67	106
24	65	10	100.0	33	57	67	78	98	155
24	71	10	100.0	16	27	32	37	46	73
24	75	10	100.0	5	9	11	13	16	26
24	76	10	100.0	7	12	14	17	21	34
24	88	10	100.0	51	88	103	119	150	238
24	91	5	0.0	38	91	105	120	152	254
24	91	10	100.0	4	8	9	11	14	22
25	61	11	0.0	7	10	11	12	14	21
25	68	2	0.0	12	18	20	23	27	40
25	72	11	0.0	7	12	15	18	25	44
25	88	1	100.0	46	62	68	74	89	128
25	93	10	100.0	5	8	9	10	12	18
26	39	10	100.0	9	13	16	18	22	35
26	44	1	100.0	18	25	28	30	36	52
26	45	1	100.0	9	12	13	14	17	25
26	52	10	100.0	135	203	231	263	327	506
26	57	10	100.0	10	16	18	20	25	39
26	68	1	100.0	43	57	63	69	83	118
26	68	7	0.0	5	8	9	10	13	20
26	68	10	100.0	117	176	200	228	283	438
26	72	1	100.0	12	17	18	21	24	36
26	73	1	100.0	108	144	158	174	208	296
26	73	7	0.0	40	61	69	79	98	153
26	73	9	100.0	21	32	37	42	52	81
26	73	14	0.0	10	15	17	19	24	36
26	75	12	0.0	6	9	10	12	14	22
26	75	14	0.0	39	59	66	75	92	140
26	88	1	100.0	1339	1777	1956	2154	2570	3665

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
26	88	2	0.0	40	52	72	82	101	157
26	88	5	0.0	116	200	225	252	316	493
26	88	7	0.0	54	82	93	107	133	206
26	91	1	100.0	16	22	24	26	31	45
26	93	10	100.0	11	18	20	23	29	44
26	100	12	0.0	1	13	14	15	17	23
28	47	5	0.0	1227	2106	2368	2666	3324	5175
28	53	5	0.0	456	783	891	992	1237	1925
28	60	5	0.0	31	53	60	67	84	131
28	61	5	0.0	40	69	78	88	110	171
28	66	5	0.0	35	60	67	76	95	148
28	88	2	0.0	17	24	26	29	34	50
28	88	5	0.0	64	110	124	139	174	271
29	49	5	0.0	54	94	107	121	153	242
29	53	5	0.0	25	44	50	56	71	113
29	54	5	0.0	111	193	219	250	313	497
29	54	12	0.0	10	17	19	24	31	51
29	56	5	0.0	9	17	19	22	27	44
29	57	5	0.0	25	45	51	58	73	117
29	58	5	0.0	6	11	13	15	19	30
29	59	12	0.0	29	45	53	63	82	138
29	61	14	0.0	5	8	9	11	15	25
29	68	14	0.0	5	9	10	12	16	27
29	73	14	0.0	12	18	22	26	33	56
29	76	14	0.0	9	14	17	20	27	45
29	88	1	100.0	174	233	256	282	338	484
29	88	5	0.0	41	72	82	93	117	185
29	91	5	0.0	236	409	464	527	663	1049
30	39	10	100.0	11	15	17	20	25	40
30	40	10	100.0	25	35	40	45	57	90
30	43	10	100.0	10	14	16	18	23	37
30	45	10	100.0	30	42	48	55	70	110
30	51	9	100.C	10	14	16	18	23	36
30	59	10	100.0	9	12	14	16	21	33
30	61	10	100.0	6	8	9	11	14	22
30	75	10	100.0	243	339	387	444	557	874
30	88	10	100.0	54	75	86	98	123	194
31	66	10	100.0	12	17	20	23	29	45
31	71	11	0.0	12	26	33	42	57	102
31	72	11	0.0	35	61	76	92	121	213

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
31	73	6	0.0	46	80	90	103	129	205
31	90	5	0.0	9	15	17	20	25	40
32	42	5	0.0	12	27	31	36	46	76
32	44	1	100.0	14	18	20	22	27	39
32	47	5	0.0	250	532	619	719	916	1486
32	55	5	0.0	22	46	54	63	80	131
32	56	5	0.0	83	178	206	240	307	498
32	57	5	0.0	83	179	208	242	308	501
32	59	5	0.0	96	204	238	277	354	574
32	60	5	0.0	10	21	24	28	36	59
32	61	5	0.0	35	75	87	101	130	211
32	68	1	100.0	59	76	84	92	110	158
32	68	5	0.0	375	798	929	1080	1375	2230
32	72	5	0.0	5	10	12	14	18	30
32	73	1	100.0	6	8	9	10	12	17
32	88	1	100.0	185	239	264	292	349	500
32	88	5	0.0	75	159	185	216	275	446
32	88	7	0.0	224	320	360	404	497	750
32	90	5	0.0	78	166	193	224	286	464
32	91	5	0.0	220	469	546	635	808	1311
33	42	5	0.0	122	261	303	353	449	728
33	47	5	0.0	348	742	863	1003	1277	2071
33	53	5	0.0	1686	3589	4172	4850	6176	10013
33	67	1	100.0	17	22	24	27	32	47
33	68	5	0.0	819	1745	2029	2359	3004	4870
33	72	5	0.0	5	11	13	15	19	31
33	84	5	0.0	1	1227	1432	1669	2170	3529
33	88	1	100.0	91	117	129	142	171	244
33	88	5	0.0	1872	3983	4632	5384	6856	11118
33	90	5	0.0	49	105	122	142	181	294
33	92	5	0.0	13	27	32	37	47	77
33	102	5	0.0	1	503	587	684	890	1450
33	105	5	0.0	1	503	587	684	890	1450
34	56	5	0.0	7	14	17	20	25	41
34	57	5	0.0	172	368	428	498	636	1031
34	68	1	100.0	15	20	22	24	29	41
34	88	1	100.0	45	58	66	72	86	124
35	49	5	0.0	8	17	20	23	29	48
35	55	5	0.0	17	37	43	51	65	105
35	56	5	0.0	34	73	86	100	127	207

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
35	66	5	0.0	95	202	235	273	348	565
35	67	1	100.0	6	8	8	9	11	16
35	68	1	100.0	19	25	28	31	37	53
35	68	5	0.0	22	50	58	67	85	139
35	68	10	100.0	8	11	13	14	18	27
35	71	6	0.0	4	8	10	12	15	25
35	72	1	100.0	11	14	16	18	21	30
35	73	1	100.0	38	49	54	59	71	101
35	75	14	0.0	14	23	26	31	39	62
35	88	1	100.0	998	1287	1419	1564	1869	2672
35	91	1	100.0	9	12	14	15	18	27
36	40	5	0.0	4053	8626	10029	11659	14846	24068
36	40	10	100.0	10	15	17	19	23	35
36	43	1	100.0	5	7	8	9	11	15
36	44	1	100.0	11	15	17	18	22	32
36	52	10	100.0	130	186	209	235	289	436
36	54	10	100.0	54	78	88	99	121	183
36	57	10	100.0	32	45	51	57	71	107
36	59	5	0.0	5	11	13	15	19	31
36	59	10	100.0	120	171	192	216	266	401
36	61	10	100.0	89	127	144	162	199	300
36	65	10	100.0	112	160	180	202	248	375
36	66	10	100.0	16	24	28	31	39	59
36	67	1	100.0	6	7	8	9	11	16
36	68	1	100.0	17	21	25	27	32	46
36	68	10	100.0	379	543	609	685	841	1272
36	73	1	100.0	59	76	83	91	109	157
36	73	7	0.0	15	22	25	28	35	53
36	73	10	100.0	34	49	55	62	76	115
36	76	10	100.0	14	20	23	25	32	48
36	88	1	100.0	929	1197	1320	1454	1738	2487
36	88	7	0.0	22	31	37	41	50	77
36	88	10	100.0	29	41	46	52	64	97
36	91	1	100.0	15	19	21	24	29	42
36	92	1	100.0	5	7	8	9	10	15
37	40	5	0.0	2642	5624	6539	7602	9680	15695
37	45	5	0.0	5	11	13	15	19	31
37	46	5	0.0	8	18	21	25	32	51
37	49	5	0.0	1155	2458	2857	3322	4230	6858
37	56	5	0.0	4	10	11	13	17	[illegible]

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
37	67	1	100.0	36	47	51	57	68	97
37	68	5	0.0	768	1636	1903	2213	2818	4568
37	82	5	0.0	1	1846	2288	2824	4011	7636
37	84	5	0.0	1	1626	1926	2275	3096	5601
37	88	1	100.0	289	373	411	453	543	776
37	88	5	0.0	101	216	250	292	371	602
37	90	5	0.0	1169	2489	2894	3364	4284	6945
37	91	5	0.0	304	647	752	875	1114	1806
37	93	5	0.0	11	25	29	34	43	71
37	102	5	0.0	1	2118	2456	2849	3663	5843
38	53	6	0.0	1274	2246	2577	2957	3770	6131
38	53	11	0.0	109	160	189	222	286	477
38	55	5	0.0	42	74	85	97	124	204
38	56	5	0.0	81	144	165	190	243	397
38	68	5	0.0	693	1222	1402	1609	2052	3337
38	88	1	100.0	19	26	29	31	38	54
38	88	4	0.0	6	12	15	19	25	45
38	91	5	0.0	26	47	54	62	79	129
39	7	14	0.0	5	11	13	16	21	37
39	8	14	0.0	13	25	31	39	51	89
39	19	9	100.0	11	17	18	22	28	43
39	55	12	0.0	10	19	23	28	37	64
39	59	14	0.0	5	9	12	15	21	36
39	72	11	0.0	21	36	44	55	73	130
39	73	12	0.0	41	78	95	115	152	262
39	73	14	0.0	8	16	20	24	32	55
39	75	14	0.0	9	18	22	28	36	63
39	76	14	0.0	32	62	77	94	124	216
39	88	14	0.0	6	13	15	19	26	44
39	93	6	0.0	13	29	34	40	52	87
40	39	6	0.0	250	555	657	778	1005	1681
40	59	10	100.0	5	8	9	10	13	21
40	73	1	100.0	13	14	15	16	19	25
40	88	1	100.0	79	91	97	102	119	158
40	92	5	0.0	9	16	18	21	27	45
41	40	4	0.0	14	27	32	40	52	92
41	41	6	0.0	46	114	137	164	214	359
41	42	2	0.0	76	107	119	134	165	249
41	59	4	0.0	8	11	12	13	17	24
41	59	12	0.0	7	12	15	18	23	41

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
41	65	10	100.0	8	13	15	18	22	36
41	84	12	0.0	1	79	88	99	118	163
41	105	5	0.0	1	1353	1581	1842	2391	3890
41	105	6	0.0	1	64	71	80	96	138
42	42	2	0.0	18	28	31	36	44	68
42	44	9	100.0	9	13	15	17	21	34
42	49	9	100.0	14	21	24	27	34	54
42	51	9	100.0	7	11	12	14	18	28
42	74	8	0.0	5	11	13	16	22	40
42	84	5	0.0	1	4305	5148	6092	8295	13922
43	43	6	0.0	752	1856	2215	2644	3416	5706
43	44	5	0.0	157	387	462	552	713	1192
43	44	6	0.0	7	17	20	24	31	53
43	47	5	0.0	73	181	217	259	334	559
43	56	5	0.0	52	128	153	182	236	394
43	73	7	0.0	28	41	47	54	68	106
43	74	14	0.0	5	9	11	14	18	32
43	84	5	0.0	1	2477	2962	3505	4774	8008
43	84	12	0.0	1	102	113	126	150	207
43	84	14	0.0	1	11	16	21	40	123
43	88	7	0.0	28	44	49	58	72	114
43	91	5	0.0	18	45	54	64	83	139
44	23	10	100.0	5	8	9	11	14	22
44	24	10	100.0	10	17	19	22	28	44
44	42	2	0.0	340	561	647	747	940	1489
44	43	6	0.0	372	869	1030	1223	1579	2631
44	44	5	0.0	1151	2769	3297	3924	5069	8457
44	45	6	0.0	22	47	55	65	84	140
44	73	7	0.0	24	38	43	50	64	100
44	84	2	0.0	1	10	12	13	17	27
44	84	4	0.0	1	12	13	15	18	25
44	84	5	0.0	1	3344	3999	4735	6447	10820
44	88	7	0.0	70	110	127	147	186	292
45	6	10	100.0	14	22	26	29	37	59
45	12	5	0.0	29	52	60	68	87	144
45	18	5	0.0	22	39	44	51	65	107
45	20	9	100.0	24	38	44	51	64	101
45	44	6	0.0	47	84	96	110	141	232
45	45	2	0.0	28	46	53	62	78	123
45	45	6	0.0	123	218	250	286	366	60[illegible]

RWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
45	45	8	0.0	154	309	372	446	577	962
45	45	9	100.0	14	21	25	29	36	57
45	47	5	0.0	46	81	93	106	136	224
45	54	12	0.0	12	25	30	37	49	83
45	73	7	0.0	35	55	63	74	93	145
45	75	9	100.0	17	28	33	37	48	76
45	75	10	100.0	198	310	357	411	516	813
45	84	1	100.0	1	84	96	109	141	232
45	84	5	0.0	1	1416	1692	2002	2727	4568
45	84	12	0.0	1	79	88	99	118	163
45	84	14	0.0	1	14	16	18	23	36
45	88	1	100.0	17	16	17	19	22	30
45	88	7	0.0	240	376	433	500	627	988
46	26	9	100.0	11	17	19	22	28	45
46	29	9	100.0	5	7	9	10	13	20
46	49	9	100.0	35	55	64	74	93	146
46	57	9	100.0	8	12	14	16	21	33
46	59	9	100.0	16	25	29	34	42	67
46	61	9	100.0	11	18	21	25	31	50
46	63	9	100.0	7	10	12	14	18	28
46	65	9	100.0	6	9	10	12	15	24
46	68	9	100.0	18	29	34	39	49	78
46	75	9	100.0	10	16	18	21	26	42
47	26	9	100.0	11	17	19	23	29	47
47	32	5	0.0	158	280	320	366	469	771
47	44	5	0.0	35	62	71	82	105	172
47	45	9	100.0	6	9	11	13	16	26
47	47	5	0.0	8	15	17	19	25	41
47	56	9	100.0	10	15	18	21	28	44
47	57	9	100.0	10	16	19	22	28	45
47	59	9	100.0	17	28	33	39	50	78
47	63	9	100.0	21	32	38	44	56	88
47	66	9	100.0	8	12	14	17	21	35
49	14	5	0.0	8	18	21	25	32	54
49	28	5	0.0	7	17	20	24	32	53
49	37	5	0.0	10	22	27	32	41	69
49	39	6	0.0	5	12	15	18	23	38
49	40	6	0.0	54	85	94	103	126	188
49	47	6	0.0	70	111	122	135	165	245
49	49	6	0.0	538	886	985	1098	1352	2054

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
49	65	10	100.0	6	9	11	12	16	26
49	75	7	0.0	6	10	11	12	16	26
49	76	14	0.0	9	19	22	27	37	64
49	84	6	0.0	1	454	520	597	757	1195
49	88	1	100.0	9	9	9	9	11	14
49	102	5	0.0	1	391	454	526	675	1078
50	36	6	0.0	12	22	25	29	37	61
50	47	5	0.0	2023	3565	4091	4694	5985	9733
50	53	6	0.0	8	14	16	18	24	39
50	56	5	0.0	7	12	14	17	21	35
50	57	5	0.0	88	156	179	205	263	427
50	66	5	0.0	6	12	13	15	20	33
50	67	6	0.0	49	87	101	115	147	240
50	68	6	0.0	332	586	674	774	986	1606
50	71	6	0.0	164	290	334	383	489	796
50	71	14	0.0	62	91	109	128	166	279
50	72	6	0.0	92	164	189	217	277	452
50	72	14	0.0	582	856	1004	1180	1526	2541
50	73	6	0.0	880	1550	1779	2042	2603	4234
50	73	14	0.0	71	105	123	144	187	313
50	88	1	100.0	35	40	43	45	52	69
50	88	6	0.0	45	81	93	107	137	223
50	88	14	0.0	466	683	803	944	1219	2031
50	91	5	0.0	68	121	139	160	204	334
50	93	5	0.0	8	15	17	20	25	41
50	93	14	0.0	32	47	55	65	84	141
51	12	12	0.0	15	23	27	32	42	71
51	16	4	0.0	8	12	13	15	19	29
51	16	6	0.0	22	40	46	53	67	109
51	16	12	0.0	28	41	49	57	74	123
51	17	14	0.0	12	17	20	24	31	52
51	26	9	100.0	20	30	34	40	51	80
51	29	9	100.0	23	34	39	45	57	90
51	38	14	0.0	20	30	35	41	53	89
51	44	9	100.0	24	36	41	48	60	95
51	49	9	100.0	5	8	10	11	14	23
51	51	9	100.0	5	8	10	11	14	22
51	51	10	100.0	116	173	199	229	288	455
51	52	10	100.0	22	33	39	45	56	89
51	59	9	100.0	50	74	87	99	125	195

RWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
51	59	12	0.0	18	28	33	39	50	84
51	64	9	100.0	8	12	14	16	20	32
51	65	9	100.0	11	16	19	22	27	43
51	66	9	100.0	10	15	17	20	25	41
51	67	6	0.0	102	180	207	237	303	493
51	67	14	0.0	10	15	17	20	26	44
51	68	1	100.0	6	11	12	13	16	23
51	68	6	0.0	698	1231	1414	1622	2068	3364
51	68	9	100.0	59	90	102	119	149	236
51	68	11	0.0	8	14	17	20	27	47
51	68	14	0.0	376	550	647	761	984	1638
51	69	9	100.0	10	15	17	20	25	40
51	71	6	0.0	272	483	554	636	811	1321
51	71	11	0.0	49	86	104	126	166	288
51	71	14	0.0	664	973	1145	1343	1736	2890
51	72	6	0.0	7	13	14	17	21	35
51	72	14	0.0	59	86	102	119	154	258
51	73	1	100.0	24	32	35	39	47	66
51	73	6	0.0	1388	2446	2807	3221	4106	6678
51	73	10	100.0	20	30	35	40	50	80
51	73	14	0.0	738	1081	1270	1493	1926	2210
51	76	6	0.0	5	10	12	13	17	28
51	76	10	100.0	13	19	22	25	32	52
51	77	6	0.0	5	10	11	13	17	29
51	77	14	0.0	11	17	19	23	30	51
51	84	12	0.0	1	84	95	108	132	191
51	88	1	100.0	89	120	132	144	173	246
51	88	2	0.0	8	9	10	11	13	18
51	88	12	0.0	7	11	13	15	20	33
52	11	10	100.0	6	9	10	12	15	25
52	16	6	0.0	58	103	118	135	173	281
52	26	9	100.0	8	12	13	16	20	31
52	36	10	100.0	11	17	20	23	29	46
52	39	6	0.0	1137	2004	2300	2638	3364	5471
52	40	6	0.0	223	393	451	518	660	1075
52	44	12	0.0	19	28	32	38	50	83
52	50	6	0.0	453	799	916	1052	1341	2181
52	51	6	0.0	44	77	89	102	130	212
52	51	10	100.0	62	92	106	122	153	243
52	52	6	0.0	403	711	816	936	1194	1942

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
52	52	10	100.0	18	27	31	36	46	72
52	53	6	0.0	34	60	69	79	101	164
52	54	13	0.0	8	11	13	16	20	34
52	65	10	100.0	20	30	35	40	51	80
52	68	6	0.0	6	11	12	14	18	30
52	68	10	100.0	9	14	16	19	24	37
53	22	5	0.0	3774	6649	7631	8755	11163	18152
53	26	5	0.0	1014	1786	2050	2352	2999	4877
53	29	11	0.0	7	12	14	17	22	36
53	32	11	0.0	75	119	138	160	202	321
53	39	11	0.0	31	58	71	86	113	196
53	43	11	0.0	25	45	54	66	86	147
53	45	11	0.0	28	58	69	84	108	180
53	59	11	0.0	85	115	126	138	166	238
53	61	11	0.0	9	13	15	16	19	27
53	68	5	0.0	11	20	23	26	34	55
53	68	11	0.0	193	336	408	495	652	1128
53	73	5	0.0	82	144	166	190	243	395
53	73	11	0.0	11	21	27	33	45	80
53	88	1	100.0	25	34	37	41	49	70
53	88	11	0.0	102	201	252	315	422	754
54	29	1	100.0	10	13	15	16	20	30
54	30	10	100.0	9	13	15	17	21	33
54	32	15	100.0	21	30	34	38	47	71
54	36	1	100.0	34	44	50	55	68	100
54	39	10	100.0	18	26	29	34	42	64
54	43	1	100.0	157	203	226	254	307	452
54	43	7	0.0	13	19	21	24	30	46
54	44	1	100.0	71	92	103	116	141	207
54	44	7	0.0	7	11	12	14	18	27
54	45	1	100.0	82	107	119	134	163	239
54	45	7	0.0	6	8	9	11	13	21
54	47	9	100.0	19	29	33	37	46	72
54	84	1	100.0	1	112	119	126	139	170
54	86	9	100.0	1	57	61	65	74	96
54	91	1	100.0	39	52	58	65	80	116
55	44	1	100.0	5	7	8	9	11	17
55	45	1	100.0	9	12	13	15	18	27
56	44	4	0.0	13	27	32	39	50	84
57	43	1	100.0	36	41	42	47	54	72

RWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
57	44	1	100.0	42	47	52	54	64	85
57	45	1	100.0	54	61	66	71	81	109
57	91	1	100.0	34	37	38	42	50	67
58	5	6	0.0	19	42	50	59	77	127
58	12	6	0.0	8	19	22	26	34	57
58	26	7	0.0	23	32	34	36	43	61
58	36	9	100.0	29	40	43	46	54	77
58	39	11	0.0	88	167	203	247	325	561
58	84	11	0.0	1	107	122	140	178	282
58	91	1	100.0	20	21	22	26	32	42
58	91	11	0.0	5	10	13	16	21	37
58	93	11	0.0	70	138	173	217	290	519
59	9	14	0.0	18	25	28	31	36	55
59	13	9	100.0	6	8	9	10	11	17
59	13	14	0.0	8	10	11	13	15	22
59	16	10	100.0	21	29	32	35	42	61
59	16	15	100.0	68	88	99	112	139	213
59	20	10	100.0	7	10	10	11	14	20
59	24	10	100.0	28	37	40	44	53	76
59	29	12	0.0	68	92	101	110	133	191
59	32	10	100.0	36	48	52	57	69	100
59	34	10	100.0	6	8	9	10	12	17
59	35	12	0.0	10	15	16	18	22	32
59	39	12	0.0	39	55	60	66	79	115
59	43	12	0.0	15	21	22	25	30	43
59	44	1	100.0	10	12	14	15	18	25
59	44	7	0.0	8	10	11	12	15	22
59	44	10	100.0	47	62	69	74	90	128
59	44	12	0.0	37	51	57	63	75	109
59	44	14	0.0	6	9	10	11	13	19
59	45	1	100.0	7	9	10	11	13	18
59	45	9	100.0	9	12	14	15	18	26
59	45	10	100.0	9	13	14	15	18	26
59	45	12	0.0	15	21	23	25	31	45
59	47	12	0.0	7	9	10	11	14	19
59	51	14	0.0	10	14	16	18	21	31
59	84	9	100.0	1	37	47	59	86	170
59	84	12	0.0	1	22	25	29	34	48
59	91	10	100.0	12	15	17	19	22	32
59	93	5	0.0	5	9	11	12	15	24

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
59	93	10	100.0	8	9	10	10	15	22
59	93	12	0.0	8	12	12	14	17	25
59	93	14	0.0	10	15	16	18	22	32
59	95	12	0.0	1	73	86	102	135	235
59	96	12	0.0	1	150	164	181	217	283
60	26	10	100.0	11	15	16	18	21	31
60	42	10	100.0	11	15	16	18	21	31
60	43	10	100.0	10	14	15	16	20	28
60	44	1	100.0	11	14	15	17	21	29
60	44	10	100.0	22	29	32	34	41	59
60	45	1	100.0	9	10	11	13	15	22
60	91	1	100.0	10	12	13	14	17	24
60	93	10	100.0	31	40	43	49	58	83
61	29	12	0.0	7	10	11	12	14	20
61	39	12	0.0	16	23	25	27	33	48
61	43	1	100.0	9	12	13	14	16	24
61	44	1	100.0	170	207	226	242	286	395
61	45	1	100.0	194	238	256	278	328	454
61	91	1	100.0	92	110	121	133	157	219
61	93	12	0.0	8	13	14	16	19	28
62	10	12	0.0	10	15	17	19	24	36
62	91	1	100.0	7	8	9	9	11	15
63	36	1	100.0	67	74	78	83	95	125
63	43	1	100.0	26	30	32	34	39	53
63	44	7	0.0	33	42	47	52	64	94
63	45	1	100.0	47	56	60	66	77	107
64	36	1	100.0	17	19	20	22	25	33
64	42	1	100.0	7	8	8	8	10	13
64	43	1	100.0	243	269	284	299	344	453
64	45	1	100.0	22	24	25	27	31	41
65	5	10	100.0	10	13	14	15	18	26
65	6	10	100.0	8	10	11	12	15	21
65	7	10	100.0	9	11	12	13	16	22
65	8	6	0.0	5	12	13	16	20	32
65	8	7	0.0	34	43	47	51	61	86
65	8	10	100.0	16	22	25	28	33	49
65	12	9	100.0	8	13	15	18	23	37
65	12	10	100.0	18	22	24	26	31	45
65	13	10	100.0	81	104	113	123	146	206
65	13	12	0.0	97	142	160	181	223	338

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
65	24	10	100.0	22	29	31	34	40	57
65	26	7	0.0	30	39	42	46	55	78
65	26	10	100.0	118	151	165	179	213	301
65	29	10	100.0	104	133	145	158	187	264
65	30	10	100.0	20	26	28	31	36	52
65	32	10	100.0	9	11	13	14	17	24
65	35	10	100.0	261	334	363	395	469	661
65	39	10	100.0	126	161	174	191	226	319
65	41	1	100.0	21	24	25	27	32	43
65	41	10	100.0	128	164	178	194	230	324
65	42	10	100.0	110	141	153	166	198	279
65	43	1	100.0	21	24	26	28	33	44
65	43	10	100.0	149	191	207	225	268	378
65	44	10	100.0	10	13	14	16	19	27
65	45	1	100.0	39	46	49	52	61	82
65	45	10	100.0	58	75	81	89	105	148
65	48	10	100.0	21	27	29	32	38	53
65	49	10	100.0	40	52	56	61	73	102
65	51	9	100.0	14	18	19	21	25	35
65	52	10	100.0	26	33	36	39	46	65
65	91	1	100.0	16	18	20	21	24	33
65	93	10	100.0	46	60	65	70	84	118
66	8	6	0.0	5	12	14	16	20	33
66	12	11	0.0	114	153	171	189	229	336
66	13	11	0.0	10	14	16	18	22	34
66	25	6	0.0	8	18	20	24	30	48
66	26	9	100.0	14	18	19	21	25	35
66	26	10	100.0	9	12	13	15	17	25
66	26	11	0.0	168	251	283	319	393	593
66	39	9	100.0	62	80	87	95	113	159
66	39	10	100.0	9	13	14	14	18	25
66	45	1	100.0	14	17	18	19	22	30
66	47	5	0.0	1573	3295	3810	4406	5573	8911
66	52	10	100.0	9	11	12	14	16	23
66	52	11	0.0	31	46	54	63	81	136
66	82	1	100.0	1	82	96	111	143	227
66	84	1	100.0	1	170	211	259	371	740
66	84	5	0.0	1	221	258	301	390	629
66	93	5	0.0	35	75	86	100	126	202
66	93	6	0.0	26	56	65	75	95	152

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
66	100	12	0.0	1	10	11	12	14	18
67	25	6	0.0	29	60	70	81	103	164
67	44	1	100.0	7	9	9	10	11	16
67	45	1	100.0	7	8	8	9	10	14
67	84	1	100.0	1	46	56	67	94	179
68	6	4	0.0	26	35	39	42	50	71
68	6	9	100.0	10	15	17	20	26	41
68	7	10	100.0	53	81	94	110	139	222
68	8	14	0.0	9	16	20	25	32	56
68	12	10	100.0	14	22	25	30	38	61
68	12	12	0.0	7	13	17	20	26	47
68	13	10	100.0	24	37	43	51	65	104
68	19	10	100.0	154	237	275	320	404	648
68	26	9	100.0	79	120	141	163	207	332
68	26	10	100.0	14	23	26	30	39	62
68	26	15	100.0	15	22	25	29	36	56
68	29	9	100.0	5	8	9	11	14	23
68	29	10	100.0	71	109	127	147	186	298
68	30	10	100.0	15	23	28	32	41	66
68	32	10	100.0	11	17	20	23	30	49
68	35	9	100.0	29	46	53	61	78	125
68	35	10	100.0	53	81	95	110	139	224
68	36	10	100.0	40	62	72	83	106	169
68	39	10	100.0	54	84	98	114	144	231
68	40	5	0.0	11	18	20	22	27	40
68	47	9	100.0	5	8	9	11	14	23
68	50	9	100.0	7	11	13	15	19	31
68	91	1	100.0	19	20	20	22	25	33
68	91	10	100.0	5	8	9	11	14	22
68	93	14	0.0	9	16	20	24	32	56
69	12	10	100.0	6	10	11	13	17	29
69	13	5	0.0	8	11	12	12	13	16
69	13	10	100.0	11	18	21	25	32	53
69	26	9	100.0	25	40	47	55	70	116
69	32	10	100.0	32	49	58	68	88	144
69	35	9	100.0	44	68	80	93	120	197
69	43	1	100.0	49	52	54	57	65	85
69	43	10	100.0	55	86	101	118	151	250
69	45	1	100.0	29	31	32	34	39	51
69	47	5	0.0	6	9	10	10	10	12

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGF (KTONS) 1990	2000	2010	2020	2030
69	48	10	100.0	40	63	73	86	111	182
69	90	5	0.0	97	142	147	150	164	195
69	91	5	0.0	11	16	17	18	19	23
69	92	5	0.0	9	14	15	15	17	20
69	93	5	0.0	37	51	52	53	56	65
69	93	10	100.0	9	14	16	19	24	40
71	30	10	100.0	18	28	33	39	50	81
71	43	10	100.0	12	19	22	26	33	53
71	49	10	100.0	8	13	15	18	23	38
71	91	1	100.0	23	28	29	31	37	52
72	20	9	100.0	15	24	29	35	45	76
72	32	10	100.0	11	19	24	29	38	67
72	32	15	100.0	13	18	21	23	29	44
72	48	10	100.0	6	11	13	15	20	34
72	89	9	100.0	36	56	65	76	97	155
72	91	1	100.0	9	11	12	14	17	24
72	91	10	100.0	7	11	14	16	21	36
72	91	15	100.0	9	14	16	18	23	37
73	5	4	0.0	6	9	10	10	13	18
73	5	10	100.0	11	20	24	29	39	68
73	6	4	0.0	317	424	463	505	600	849
73	6	6	0.0	9	11	12	12	12	14
73	6	10	100.0	59	103	126	153	201	350
73	6	12	0.0	45	86	108	134	179	320
73	7	6	0.0	10	12	12	12	13	15
73	7	10	100.0	35	62	75	91	121	210
73	7	12	0.0	10	19	23	29	39	70
73	8	4	0.0	10	13	15	17	19	28
73	8	9	100.0	24	42	51	62	81	142
73	8	10	100.0	45	79	95	116	153	266
73	8	12	0.0	17	31	40	50	67	119
73	9	9	100.0	52	92	112	136	179	312
73	9	10	100.0	46	80	98	119	157	272
73	9	12	0.0	15	29	36	46	61	109
73	10	4	0.0	10	14	15	17	20	29
73	10	6	0.0	8	11	11	11	12	13
73	10	12	0.0	11	22	27	34	46	82
73	11	4	0.0	35	48	52	57	68	96
73	11	9	100.0	26	45	55	67	89	154
73	11	10	100.0	167	293	356	432	569	988

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
73	11	12	0.0	20	38	48	60	80	142
73	12	4	0.0	41	57	63	71	87	131
73	12	6	0.0	56	70	70	71	76	86
73	12	9	100.0	32	57	70	84	111	194
73	12	10	100.0	306	538	652	792	1045	1816
73	12	12	0.0	181	344	429	534	714	1271
73	13	4	0.0	89	125	140	158	194	295
73	13	9	100.0	6	11	13	16	22	38
73	13	10	100.0	25	44	54	65	86	150
73	14	9	100.0	623	1095	1329	1613	2126	3693
73	14	10	100.0	20	37	45	54	73	129
73	16	4	0.0	163	247	279	315	389	590
73	16	9	100.0	200	351	426	517	682	1184
73	16	10	100.0	113	199	242	294	387	673
73	16	12	0.0	13	26	32	40	54	96
73	16	15	100.0	22	29	32	36	45	69
73	17	4	0.0	84	120	135	152	188	289
73	17	9	100.0	210	368	446	542	715	1241
73	18	4	0.0	8	12	13	15	19	29
73	18	10	100.0	173	303	368	447	590	1024
73	19	9	100.0	35	61	74	90	119	207
73	20	6	0.0	19	24	24	24	26	30
73	20	9	100.0	91	160	194	235	310	539
73	20	10	100.0	314	551	669	812	1071	1859
73	22	10	100.0	5	9	11	13	17	30
73	23	4	0.0	124	192	222	258	327	525
73	23	9	100.0	81	143	174	212	280	485
73	23	10	100.0	44	79	96	117	155	271
73	25	4	0.0	33	47	52	58	71	106
73	25	6	0.0	15	19	19	19	20	23
73	25	9	100.0	16	28	34	41	54	96
73	25	12	0.0	13	25	32	39	53	94
73	26	4	0.0	269	403	455	513	631	955
73	26	7	0.0	6	12	14	17	23	40
73	26	9	100.0	459	805	978	1187	1565	2717
73	26	10	100.0	114	200	243	295	389	676
73	28	9	100.0	30	54	65	79	104	182
73	29	9	100.0	12	21	26	31	42	73
73	29	10	100.0	230	404	491	596	785	1364
73	30	9	100.0	53	93	113	138	182	316

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
73	30	10	100.0	72	126	153	186	246	427
73	31	10	100.0	15	27	33	40	53	92
73	32	9	100.0	478	838	1018	1235	1628	2828
73	32	10	100.0	28	49	61	74	97	169
73	35	9	100.0	73	129	157	191	251	437
73	35	10	100.0	16	29	35	43	56	98
73	36	9	100.0	37	66	80	97	129	224
73	36	10	100.0	48	85	103	125	165	287
73	38	4	0.0	17	25	30	35	46	76
73	39	10	100.0	163	288	350	424	559	972
73	41	10	100.0	8	14	17	20	27	48
73	42	10	100.0	11	20	25	30	40	69
73	43	9	100.0	59	103	125	152	201	349
73	44	9	100.0	97	171	208	252	332	577
73	45	9	100.0	7	12	15	18	24	42
73	46	9	100.0	6	11	13	16	21	37
73	49	4	0.0	82	155	188	229	301	520
73	49	9	100.0	313	552	671	814	1073	1864
73	49	10	100.0	50	89	108	131	172	300
73	50	9	100.0	5	8	10	12	17	29
73	52	10	100.0	60	106	128	156	205	257
73	52	12	0.0	5	10	12	15	21	37
73	53	10	100.0	8	14	17	21	27	48
73	89	9	100.0	167	293	356	433	570	992
73	89	10	100.0	19	33	41	49	65	114
73	90	9	100.0	11	19	24	29	38	67
73	90	10	100.0	28	49	60	73	96	168
73	91	4	0.0	23	45	56	70	92	164
73	91	9	100.0	63	112	136	166	218	380
73	91	10	100.0	140	245	299	360	477	829
73	93	4	0.0	8	16	21	27	35	64
73	93	9	100.0	8	15	19	23	30	52
73	93	10	100.0	143	251	306	372	490	851
73	93	14	0.0	40	76	95	119	159	283
73	95	9	100.0	1	460	547	646	863	1469
73	95	12	0.0	1	11	12	13	15	20
73	98	4	0.0	44	68	80	93	165	198
73	98	9	100.0	9	17	21	25	33	58
73	98	12	0.0	15	30	37	46	62	111
73	100	9	100.0	11	20	25	30	40	70

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
73	103	9	100.0	8	15	19	23	30	52
73	105	9	100.0	38	68	82	100	132	230
74	6	6	0.0	8	9	9	8	9	10
74	7	6	0.0	14	15	15	15	15	17
74	8	6	0.0	7	7	7	7	7	8
74	9	6	0.0	12	13	13	13	14	15
74	9	9	100.0	9	15	18	22	28	47
74	10	6	0.0	7	7	7	7	7	8
74	11	9	100.0	54	90	107	127	164	271
74	12	6	0.0	60	65	64	63	66	74
74	12	12	0.0	4	11	15	19	26	47
74	20	9	100.0	50	97	115	139	179	299
74	23	9	100.0	49	83	99	117	151	250
74	25	6	0.0	9	10	10	10	10	11
74	26	6	0.0	9	10	10	10	10	11
74	32	9	100.0	433	727	862	1025	1319	2183
74	32	12	0.0	11	24	30	37	51	92
74	34	4	0.0	73	116	133	155	196	312
74	34	9	100.0	219	369	439	520	669	1108
74	34	14	0.0	6	12	15	18	25	46
74	38	6	0.0	8	8	8	8	9	10
74	39	9	100.0	9	17	20	25	32	52
74	40	12	0.0	4	11	15	19	26	48
74	44	9	100.0	73	122	144	171	219	364
74	49	9	100.0	6	11	13	16	21	35
74	91	9	100.0	23	39	47	56	72	120
74	91	10	100.0	6	10	12	14	18	31
74	91	15	100.0	21	30	35	40	51	81
74	98	6	0.0	8	8	8	8	8	10
75	5	10	100.0	38	64	76	90	116	194
75	6	10	100.0	18	32	39	45	58	97
75	7	10	100.0	186	309	367	435	560	928
75	8	9	100.0	31	54	63	77	98	164
75	8	10	100.0	162	272	324	384	492	819
75	9	9	100.0	34	57	68	80	103	171
75	9	10	100.0	6	12	13	17	22	37
75	9	12	0.0	13	29	36	45	62	112
75	10	10	100.0	10	17	20	24	31	52
75'	10	12	0.0	5	12	15	19	26	48
75	11	9	100.0	210	346	408	484	623	1031

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
75	11	10	100.0	26	44	53	63	80	136
75	12	9	100.0	33	56	66	80	102	169
75	12	10	100.0	47	79	94	111	145	240
75	12	12	0.0	3	8	10	12	18	32
75	13	10	100.0	4	7	9	11	14	24
75	14	9	100.0	27	48	55	67	85	143
75	15	9	100.0	12	20	23	28	36	60
75	16	9	100.0	40	69	81	96	124	206
75	16	10	100.0	12	20	23	28	36	59
75	16	12	0.0	5	12	15	19	25	46
75	16	15	100.0	11	15	17	19	23	36
75	19	9	100.0	8	14	16	21	27	45
75	19	10	100.0	16	26	31	37	48	79
75	20	9	100.0	340	567	672	796	1024	1696
75	20	10	100.0	52	87	102	121	156	260
75	23	9	100.0	115	193	230	272	351	584
75	23	10	100.0	43	73	86	102	131	219
75	24	10	100.0	7	12	14	17	22	36
75	26	9	100.0	315	528	625	740	952	1580
75	26	10	100.0	33	55	65	78	101	168
75	28	10	100.0	14	24	28	34	44	74
75	29	10	100.0	75	125	148	175	227	375
75	30	9	100.0	210	351	416	493	635	1052
75	30	10	100.0	6	10	11	14	18	30
75	32	10	100.0	12	21	24	29	38	62
75	36	9	100.0	39	66	79	93	119	198
75	36	10	100.0	5	9	10	12	16	27
75	39	9	100.0	84	142	168	200	257	427
75	39	10	100.0	23	39	45	54	70	118
75	41	9	100.0	12	20	24	28	37	61
75	41	10	100.0	5	9	11	13	17	28
75	43	9	100.0	8	13	16	19	25	41
75	43	10	100.0	26	44	52	63	81	135
75	45	9	100.0	644	1073	1272	1506	1937	3208
75	45	10	100.0	17	29	35	41	53	88
75	46	9	100.0	15	26	30	37	46	78
75	47	10	100.0	6	10	12	15	19	32
75	49	10	100.0	21	35	42	50	65	107
75	51	9	100.0	219	366	433	514	660	1094
75	51	15	100.0	39	59	68	78	98	155

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
75	89	9	100.0	22	38	46	55	71	119
75	89	10	100.0	118	197	234	277	358	593
75	89	14	0.0	7	16	20	25	35	63
75	90	9	100.0	153	255	302	358	462	765
75	90	10	100.0	24	41	49	57	74	124
75	91	9	100.0	372	622	736	873	1123	1862
75	91	10	100.0	263	441	522	620	799	1323
75	91	12	0.0	4	12	15	20	28	51
75	93	4	0.0	5	10	12	17	22	40
75	93	10	100.0	25	43	51	61	78	129
75	98	10	100.0	19	32	37	45	59	98
75	100	9	100.0	73	121	143	170	219	363
75	103	10	100.0	21	35	42	50	65	108
75	104	10	100.0	23	39	47	56	72	119
76	5	12	0.0	17	33	41	51	68	121
76	8	9	100.0	36	58	68	82	106	176
76	8	10	100.0	83	133	158	188	243	410
76	9	9	100.0	29	53	64	79	105	184
76	9	10	100.0	72	122	147	178	233	397
76	11	9	100.0	12	19	22	26	34	56
76	11	10	100.0	25	40	48	56	72	119
76	12	9	100.0	6	9	11	13	17	29
76	12	10	100.0	34	54	65	75	98	163
76	13	10	100.0	14	25	31	38	50	88
76	14	9	100.0	40	72	86	105	137	238
76	14	10	100.0	21	38	46	55	72	126
76	16	9	100.0	6	10	11	13	17	29
76	19	9	100.0	195	304	357	421	541	892
76	19	10	100.0	9	13	17	19	26	42
76	20	9	100.0	14	23	27	32	41	68
76	22	9	100.0	9	17	21	26	35	61
76	23	9	100.0	12	19	24	27	37	63
76	26	6	0.0	27	25	24	24	25	27
76	26	9	100.0	50	78	92	109	142	234
76	26	10	100.0	79	122	145	171	220	364
76	32	10	100.0	49	81	96	114	148	247
76	34	10	100.0	9	16	20	25	33	58
76	39	9	100.0	6	9	12	13	17	29
76	39	12	0.0	12	24	29	36	49	88
76	41	10	100.0	7	13	15	18	24	40

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
76	43	12	0.0	5	9	12	15	20	38
76	49	14	0.0	73	153	190	240	322	575
76	52	10	100.0	6	9	11	13	17	28
76	89	9	100.0	7	12	15	17	23	40
76	89	10	100.0	70	111	131	155	200	333
76	89	14	0.0	6	12	14	18	25	46
76	90	9	100.0	26	40	47	57	73	122
76	90	10	100.0	200	311	365	430	554	913
76	91	7	0.0	9	17	20	25	34	61
76	91	9	100.0	82	148	180	220	290	505
76	91	10	100.0	268	417	492	580	747	1233
76	91	15	100.0	9	13	15	18	23	36
76	93	10	100.0	8	15	18	23	30	54
76	98	10	100.0	11	18	22	25	33	58
76	100	9	100.0	8	14	17	20	27	48
76	103	10	100.0	16	24	29	34	45	74
77	1	6	0.0	20	28	28	28	31	33
77	7	6	0.0	107	150	152	154	163	180
77	8	6	0.0	60	84	86	86	92	102
77	10	6	0.0	5	7	7	7	8	9
77	16	6	0.0	56	79	81	82	86	96
77	19	6	0.0	48	67	68	69	74	83
77	20	6	0.0	16	22	22	23	24	27
77	23	6	0.0	21	31	31	31	33	36
77	25	6	0.0	79	110	111	113	119	133
77	26	6	0.0	410	569	577	584	616	687
77	29	6	0.0	204	284	289	292	308	342
77	30	10	100.0	63	127	156	193	255	446
77	32	6	0.0	92	129	130	133	140	156
77	32	10	100.0	25	50	62	76	101	176
77	36	6	0.0	46	64	64	66	69	77
77	36	15	100.0	29	42	47	54	66	100
77	39	6	0.0	35	50	51	51	54	60
77	41	6	0.0	6	9	10	10	10	11
77	42	6	0.0	100	138	140	142	150	167
77	46	6	0.0	138	193	196	198	211	234
77	47	6	0.0	7	10	10	10	11	12
77	48	6	0.0	6	8	8	8	9	10
77	49	6	0.0	6	9	9	10	10	11
77	51	6	0.0	338	469	475	482	509	567

RWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
77	51	9	100.0	69	140	172	212	280	491
77	52	10	100.0	47	96	118	145	192	337
77	53	6	0.0	5	8	8	8	8	9
77	90	10	100.0	5	11	14	17	22	39
77	90	15	100.0	10	12	15	16	22	35
77	91	1	100.0	9	12	13	14	17	25
77	91	6	0.0	68	95	96	97	102	114
77	93	14	0.0	19	46	60	75	103	185
77	98	9	100.0	19	39	48	59	79	138
77	105	6	0.0	122	171	173	175	186	206
80	95	9	100.0	1	223	266	315	422	722
81	96	6	0.0	1	35	41	49	64	112
82	47	9	100.0	1	32	35	37	42	55
82	88	10	100.0	769	1144	1325	1536	1937	3082
83	98	10	100.0	6	8	10	11	14	23
83	98	15	100.0	38	53	60	69	86	135
84	9	9	100.0	1	217	264	323	446	830
84	12	6	0.0	1	80	94	110	146	247
84	15	6	0.0	1	49	56	65	83	133
84	20	6	0.0	1	107	123	141	181	289
84	20	9	100.0	1	58	68	80	107	181
84	23	6	0.0	1	107	123	141	181	289
84	26	6	0.0	1	37	45	53	71	122
84	26	6	0.0	1	36	42	48	61	99
84	26	12	0.0	1	19	21	23	26	35
84	29	3	0.0	1	15	17	19	24	37
84	32	6	0.0	1	242	920	988	999	999
84	41	4	0.0	1	95	104	114	134	184
84	41	9	100.0	1	17	20	23	29	45
84	44	6	0.0	1	447	540	652	890	1555
84	44	9	100.0	1	108	131	157	217	401
84	45	2	0.0	1	63	74	86	113	190
84	45	4	0.0	1	13	14	16	19	28
84	45	9	100.0	1	108	131	157	217	401
84	45	12	0.0	1	17	19	22	28	43
84	49	4	0.0	1	51	58	65	79	111
84	49	6	0.0	1	340	382	428	519	730
84	51	4	0.0	1	84	95	108	132	191
84	51	9	100.0	1	109	132	161	222	409
84	54	3	0.0	1	15	17	20	25	40

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
84	59	8	0.0	1	38	44	51	65	107
84	59	9	100.0	1	369	454	555	772	1441
84	59	12	0.0	1	21	23	25	29	40
84	95	4	0.0	1	23	25	27	31	41
84	95	6	0.0	1	65	70	75	86	114
84	98	4	0.0	3037	4650	5434	6351	8149	13411
84	98	10	100.0	95	136	157	180	227	362
84	98	12	0.0	44	86	106	130	172	301
84	98	15	100.0	253	348	396	452	566	886
84	99	4	0.0	10	16	18	21	28	46
84	100	15	100.0	22	31	35	40	50	79
84	102	9	100.0	18	26	29	34	43	69
84	104	9	100.0	38	54	62	72	91	144
84	104	10	100.0	13	19	21	25	31	51
84	105	6	0.0	84	233	279	333	430	718
86	26	2	0.0	1	33	38	42	55	89
86	44	10	100.0	1	37	43	49	62	99
86	45	9	100.0	1	66	69	74	83	105
86	57	2	0.0	1	19	22	26	34	57
86	59	8	0.0	1	38	44	51	65	107
86	61	2	0.0	1	16	19	21	27	27
86	95	9	100.0	1	45	47	50	57	72
86	105	3	0.0	302	475	551	638	807	1293
88	5	2	0.0	5	8	11	12	16	26
88	5	10	100.0	22	37	45	54	71	124
88	5	12	0.0	9	19	24	30	41	73
88	6	4	0.0	21	28	32	34	41	58
88	6	5	0.0	10	12	12	12	12	14
88	6	10	100.0	120	196	238	287	377	652
88	6	12	0.0	4	9	11	14	19	34
88	7	10	100.0	102	167	202	243	320	554
88	8	10	100.0	8	13	17	20	26	46
88	9	9	100.0	23	38	46	55	73	126
88	9	10	100.0	23	37	45	55	72	125
88	10	12	0.0	49	98	123	154	207	369
88	11	10	100.0	34	56	67	81	107	185
88	11	12	0.0	5	11	14	18	24	45
88	12	4	0.0	8	12	13	15	19	29
88	12	6	0.0	44	53	52	52	55	62
88	12	9	100.0	8	13	16	19	26	47

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
88	12	10	100.0	91	153	184	222	293	509
88	12	12	0.0	129	257	322	403	539	965
88	13	4	0.0	18	26	29	33	42	64
88	13	10	100.0	45	74	89	107	141	244
88	14	6	0.0	37	44	44	44	46	51
88	14	9	100.0	16	26	32	39	51	89
88	14	12	0.0	9	20	26	32	43	79
88	16	2	0.0	7	10	12	15	19	31
88	16	4	0.0	32	50	57	63	78	121
88	16	9	100.0	79	130	157	189	249	430
88	16	12	0.0	16	32	41	51	68	122
88	17	12	0.0	14	29	37	46	63	113
88	19	9	100.0	7	11	14	17	22	39
88	20	6	0.0	44	52	52	52	55	61
88	20	9	100.0	76	125	152	183	241	417
88	22	9	100.0	7	13	15	18	24	43
88	23	6	0.0	28	33	33	33	35	39
88	23	9	100.0	77	128	155	189	248	431
88	23	15	100.0	20	34	40	46	58	92
88	24	10	100.0	12	20	24	29	38	66
88	25	6	0.0	12	15	15	15	16	17
88	25	12	0.0	6	13	17	21	29	53
88	26	4	0.0	12	18	21	22	29	43
88	26	6	0.0	43	50	50	50	54	59
88	26	7	0.0	50	82	98	119	158	272
88	26	8	0.0	6	10	11	12	15	23
88	26	9	100.0	254	420	506	612	807	1396
88	26	10	100.0	55	91	109	132	173	301
88	26	12	0.0	147	291	365	457	612	1093
88	28	12	0.0	4	9	11	14	19	35
88	29	7	0.0	9	16	19	23	31	53
88	29	9	100.0	29	46	56	69	91	157
88	29	12	0.0	35	69	86	108	146	261
88	30	9	100.0	8	13	16	20	26	45
88	30	10	100.0	647	1062	1281	1545	2033	3516
88	31	10	100.0	4	8	9	12	15	28
88	32	9	100.0	12	20	24	30	40	69
88	32	10	100.0	191	315	380	461	607	1050
88	32	15	100.0	81	117	131	148	182	275
88	34	10	100.0	14	24	29	36	47	82

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
88	35	9	100.0	64	105	128	154	203	351
88	35	10	100.0	85	139	168	203	267	462
88	35	12	0.0	8	18	23	29	38	69
88	36	9	100.0	23	38	46	56	73	128
88	36	10	100.0	33	55	67	80	106	183
88	36	12	0.0	5	11	14	18	24	43
88	36	15	100.0	254	365	410	460	566	854
88	39	7	0.0	7	12	15	18	24	42
88	39	9	100.0	75	122	148	179	236	408
88	39	10	100.0	53	87	105	127	167	290
88	39	12	0.0	118	240	301	378	506	907
88	39	14	0.0	6	13	16	21	28	51
88	41	7	0.0	5	8	10	12	16	29
88	41	9	100.0	5	9	11	13	18	31
88	41	10	100.0	7	11	14	17	22	38
88	43	7	0.0	20	33	40	48	64	111
88	43	10	100.0	43	70	85	102	134	233
88	43	12	0.0	12	24	31	39	54	96
88	44	1	100.0	18	21	23	25	30	[illegible]
88	44	7	0.0	50	85	102	124	163	283
88	44	9	100.0	19	32	38	46	61	106
88	45	7	0.0	12	20	24	29	38	68
88	45	9	100.0	16	28	33	40	53	94
88	45	10	100.0	9	16	19	23	31	53
88	47	10	100.0	115	189	229	275	363	628
88	48	10	100.0	43	71	86	104	137	237
88	49	4	0.0	24	45	55	67	89	153
88	49	10	100.0	5	9	11	13	18	31
88	49	12	0.0	13	27	34	43	57	104
88	50	9	100.0	27	45	54	65	86	148
88	52	6	0.0	6	7	7	7	7	8
88	52	10	100.0	423	694	836	1010	1329	2296
88	52	12	0.0	10	21	27	35	46	84
88	82	10	100.0	25	40	47	54	69	110
88	82	11	0.0	24	43	54	65	86	150
88	88	1	100.0	81	95	101	111	131	181
88	88	6	0.0	2154	2526	2524	2522	2657	2949
88	88	7	0.0	34	59	71	89	117	206
88	88	9	100.0	1345	2207	2661	3212	4226	7311
88	88	10	100.0	6619	10847	13086	15777	20759	35896

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
88	88	11	0.0	6	14	18	23	31	57
88	88	12	0.0	24	50	63	80	107	197
88	88	14	0.0	194	386	483	605	811	1451
88	88	15	100.0	4395	7202	8684	10477	13782	23830
88	89	9	100.0	49	80	95	116	153	267
88	89	10	100.0	314	516	624	752	992	1717
88	90	5	0.0	132	155	155	155	163	181
88	90	9	100.0	71	116	140	169	222	385
88	90	10	100.0	108	179	215	261	343	593
88	90	12	0.0	6	13	16	22	29	53
88	90	15	100.0	25	33	38	44	55	88
88	91	1	100.0	34	41	44	47	58	82
88	91	2	0.0	9	14	17	20	25	40
88	91	6	0.0	47	55	55	55	58	64
88	91	7	0.0	7	11	13	16	22	38
88	91	8	0.0	12	23	29	35	47	82
88	91	9	100.0	155	255	311	375	493	856
88	91	10	100.0	856	1404	1695	2043	2691	4653
88	91	12	0.0	61	120	151	190	255	455
88	91	14	0.0	7	15	20	25	33	61
88	91	15	100.0	34	51	58	67	86	139
88	93	4	0.0	9	19	23	30	41	74
88	93	6	0.0	7	8	8	8	8	9
88	93	10	100.0	215	358	430	524	690	1204
88	93	12	0.0	7	15	18	24	32	59
88	93	15	100.0	5	9	10	13	17	29
88	98	9	100.0	16	25	32	39	52	89
88	98	12	0.0	20	41	52	64	87	157
88	100	9	100.0	5	9	10	13	17	29
88	103	9	100.0	10	16	20	24	32	55
88	105	10	100.0	16	27	33	39	52	90
89	88	1	100.0	23	28	32	35	43	61
89	88	6	0.0	39	75	87	99	120	177
89	88	7	0.0	6	8	9	11	14	22
89	88	8	0.0	110	216	271	340	454	812
90	75	15	100.0	8	13	16	19	24	41
90	76	14	0.0	6	12	15	18	23	41
90	88	1	100.0	41	50	56	61	74	105
90	88	6	0.0	97	184	211	243	294	430
90	88	7	0.0	21	27	33	37	47	75

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
90	88	10	100.0	10	13	16	17	23	36
91	26	10	100.0	360	515	592	681	860	1365
91	29	3	0.0	12	19	22	26	33	52
91	30	10	100.0	73	105	121	139	176	279
91	32	9	100.0	39	57	65	75	95	152
91	36	15	100.0	24	35	39	44	54	82
91	39	9	100.0	35	51	60	68	86	138
91	44	9	100.0	13	19	22	25	31	50
91	45	9	100.0	54	79	90	103	131	209
91	51	9	100.0	24	35	40	46	58	92
91	52	10	100.0	6	9	10	12	15	24
91	54	3	0.0	11	19	22	26	32	52
91	54	10	100.0	59	85	98	112	142	225
91	58	4	0.0	14	20	22	24	29	43
91	65	4	0.0	8	12	14	16	19	29
91	65	10	100.0	90	128	148	170	215	341
91	65	15	100.0	6	7	8	9	10	15
91	66	10	100.0	12	16	19	22	28	45
91	68	5	0.0	31	37	37	37	39	43
91	68	9	100.0	31	44	51	59	74	118
91	68	15	100.0	523	801	931	1082	1369	2191
91	69	3	0.0	9	14	17	19	24	39
91	71	9	100.0	31	45	53	61	77	124
91	71	10	100.0	5	8	9	11	14	22
91	72	15	100.0	76	122	147	175	227	383
91	73	10	100.0	60	84	98	112	142	227
91	74	9	100.0	26	39	44	50	65	104
91	74	10	100.0	6	8	10	11	14	23
91	75	9	100.0	33	47	54	62	79	126
91	75	10	100.0	496	712	820	945	1192	1895
91	75	14	0.0	5	10	13	18	24	44
91	75	15	100.0	264	442	524	621	798	1323
91	76	10	100.0	241	344	398	458	576	917
91	76	11	0.0	8	17	21	27	36	64
91	76	15	100.0	869	1357	1598	1881	2419	3996
91	77	10	100.0	6	9	10	12	16	26
91	77	11	0.0	3	8	12	14	19	37
91	77	15	100.0	151	258	311	370	499	867
91	88	1	100.0	31	30	31	34	34	54
91	88	2	0.0	4	9	10	13	16	29

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
91	88	5	0.0	7	20	24	29	37	63
91	88	6	0.0	10	32	39	45	60	102
91	88	7	0.0	35	51	58	68	85	137
91	88	8	0.0	15	30	37	47	63	114
91	88	9	100.0	13	22	26	32	42	72
91	88	10	100.0	686	981	1130	1300	1642	2607
91	88	12	0.0	7	15	18	23	30	54
91	88	14	0.0	4	11	16	19	26	47
91	88	15	100.0	635	1042	1257	1516	1994	3448
92	26	10	100.0	13	18	21	24	31	49
92	68	10	100.0	22	31	36	41	52	83
92	70	9	100.0	62	89	103	118	149	237
92	71	9	100.0	35	51	59	68	86	137
92	72	9	100.0	47	68	78	90	113	180
92	74	9	100.0	20	30	34	38	49	79
92	77	9	100.0	37	52	60	70	89	141
92	88	10	100.0	29	42	49	56	71	113
93	12	4	0.0	12	17	20	21	26	39
93	12	12	0.0	23	44	57	71	95	170
93	13	4	0.0	69	98	110	124	152	231
93	16	4	0.0	72	109	123	139	172	261
93	25	4	0.0	5	7	8	9	11	17
93	26	4	0.0	11	16	18	20	25	38
93	26	9	100.0	32	53	64	77	101	175
93	32	9	100.0	48	79	95	115	152	264
93	32	10	100.0	6	11	14	18	24	42
93	40	4	0.0	7	13	16	20	26	46
93	49	4	0.0	17	33	41	49	65	113
93	51	6	0.0	6	7	7	7	8	9
93	59	6	0.0	19	22	22	22	24	26
93	59	7	0.0	10	17	21	25	33	58
93	59	12	0.0	3	8	11	14	19	34
93	60	6	0.0	29	34	34	34	36	40
93	60	9	100.0	15	24	29	35	46	81
93	65	4	0.0	23	34	39	44	54	82
93	65	9	100.0	5	8	9	11	15	27
93	66	9	100.0	5	8	9	11	15	27
93	68	10	100.0	6	9	11	14	19	33
93	69	11	0.0	53	94	113	135	175	295
93	72	6	0.0	6	7	7	7	8	9

RWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
93	72	11	0.0	7	14	18	22	30	54
93	72	14	0.0	36	69	88	110	147	265
93	73	3	0.0	371	583	677	783	993	1589
93	73	9	100.0	10	16	19	23	31	54
93	73	11	0.0	6	12	16	20	27	48
93	73	14	0.0	38	73	92	117	156	282
93	75	11	0.0	45	100	125	156	209	377
93	76	6	0.0	10	11	11	11	12	13
93	76	9	100.0	5	8	9	11	15	27
93	76	10	100.0	6	9	11	14	18	32
93	76	11	0.0	4	9	11	15	20	36
93	76	14	0.0	42	83	105	131	176	315
93	77	3	0.0	667	1051	1219	1412	1790	2868
93	77	6	0.0	214	255	254	253	266	296
93	77	11	0.0	88	191	242	309	412	743
93	88	3	0.0	593	932	1079	1252	1587	2540
93	88	6	0.0	32	37	37	37	39	43
93	88	10	100.0	64	107	128	156	208	359
93	88	14	0.0	113	223	280	350	468	838
93	88	15	100.0	571	936	1131	1362	1791	3100
95	84	9	100.0	1	24	31	39	56	114
95	88	9	100.0	1	19	23	28	38	71
96	82	8	0.0	1	369	436	512	672	1114
96	84	1	100.0	1	340	393	456	601	1046
96	84	8	0.0	1	311	364	427	555	895
96	84	12	0.0	1	55	59	63	73	96
98	7	14	0.0	14	21	25	29	37	61
98	73	4	0.0	5	10	13	17	22	40
98	73	10	100.0	8	12	14	16	20	33
98	74	9	100.0	25	36	40	47	58	93
98	75	12	0.0	22	35	41	47	61	102
98	75	14	0.0	199	308	361	421	541	892
98	76	12	0.0	12	19	22	26	33	56
98	82	5	0.0	5	13	16	13	24	41
98	83	5	0.0	169	409	482	398	731	1215
98	83	10	100.0	31	43	49	56	70	110
98	84	5	0.0	1735	4187	4928	4067	7477	12422
98	84	10	100.0	114	157	178	203	255	399
98	84	11	0.0	72	140	173	212	281	491
98	84	15	100.0	8	12	14	16	20	32

BWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
98	88	5	0.0	22	55	64	53	98	163
98	88	10	100.0	6	8	9	10	13	21
98	88	12	0.0	14	22	25	30	38	63
98	98	5	0.0	11	27	32	26	48	81
98	98	10	100.0	25	35	39	45	56	89
98	102	5	0.0	731	1764	2076	1714	3151	5234
98	103	5	0.0	17	41	49	40	74	124
98	104	10	100.0	14	19	22	25	31	49
98	105	5	0.0	1866	4502	5299	4373	8040	13357
98	105	10	100.0	7	9	11	12	16	25
99	83	5	0.0	114	275	324	268	492	818
99	84	5	0.0	1810	4369	5142	4244	7803	12962
99	88	5	0.0	9	23	27	23	42	70
99	98	5	0.0	5	13	15	13	24	40
99	102	5	0.0	6	15	18	15	28	46
99	104	5	0.0	7	17	21	17	31	53
99	105	5	0.0	234	566	667	550	1012	1681
100	29	9	100.0	1	13	14	16	19	26
100	44	10	100.0	1	60	69	78	100	161
100	57	9	100.0	1	12	13	15	18	25
100	66	9	100.0	1	12	13	14	17	23
100	83	5	0.0	17	41	49	40	74	124
100	84	1	100.0	36	34	36	39	45	61
100	96	10	100.0	1	114	129	146	188	308
100	105	5	0.0	4	10	11	9	18	30
101	73	10	100.0	6	8	10	11	14	22
101	75	10	100.0	74	103	117	133	167	262
101	76	10	100.0	21	28	33	37	47	74
101	84	10	100.0	6	9	10	12	15	23
101	104	10	100.0	6	9	10	12	15	23
102	84	1	100.0	89	86	92	97	113	152
102	85	1	100.0	14	13	14	15	17	24
102	88	15	100.0	6	10	13	15	20	35
102	100	6	0.0	6	14	17	20	26	44
102	102	6	0.0	36	87	102	120	155	258
103	84	2	0.0	108	179	206	238	301	478
103	88	15	100.0	152	249	300	362	477	824
104	9	2	0.0	1	28	32	35	44	66
104	18	6	0.0	1	47	54	61	78	125
104	59	12	0.0	1	28	30	32	37	49

RWT STUDY TRAFFIC PROJECTIONS

Table 1

ORIGIN PE	DESTINATION PE	COMMODITY TYPE	DEDICATION FACTOR	1979 KTONS	PROJECTED TONNAGE (KTONS) 1990	2000	2010	2020	2030
104	82	2	0.0	46	76	88	101	128	203
104	83	6	0.0	5	9	11	12	16	27
104	84	1	100.0	76	71	76	81	94	128
104	84	2	0.0	185	304	352	406	511	812
104	84	6	0.0	905	1946	2273	2658	3418	5655
104	84	8	0.0	6	13	16	20	26	46
104	85	2	0.0	16	27	31	36	46	73
104	100	15	100.0	34	48	54	62	78	122
104	101	6	0.0	42	72	82	93	119	196
104	102	2	0.0	5	8	10	11	14	23
104	105	2	0.0	9	16	18	21	27	43
104	105	6	0.0	24	46	54	63	81	134
105	43	9	100.0	1	114	120	126	140	173
105	72	2	0.0	12	21	24	28	35	56
105	72	15	100.0	6	11	13	15	20	34
105	76	9	100.0	78	112	129	149	188	300
105	83	5	0.0	11	32	38	46	59	99
105	84	2	0.0	27	44	51	59	75	119
105	84	5	0.0	20	56	67	81	104	174
105	84	6	0.0	85	236	282	337	436	727
105	84	9	100.0	6	9	10	12	15	24
105	86	6	0.0	631	1746	2086	2492	3219	5369
105	88	9	100.0	11	16	19	21	27	43
105	88	15	100.0	53	88	106	128	168	291
105	103	9	100.0	6	9	10	11	15	23
105	105	2	0.0	69	113	131	151	190	302
105	105	5	0.0	7	19	23	28	36	60

TABLE 2

COMMODITY CHARACTERISTICS

	COMMODITY CLASS	TRANS. CLASS	AVG VALUE ($/TON)	ANNUAL HOLDING COST FACTOR	DENSITY (#/CU.FT.)
1	FARM PRODUCTS	3	95.62	.12	46.10
2	FOREST PRODUCTS	10	890.00	.12	45.00
3	FISH & MARINE PROD	8	5.57	.12	93.00
4	METALLIC MINERALS	1	68.53	.12	292.90
5	COAL	1	31.53	.12	51.00
6	NONMETALLIC MINERA	8	5.57	.12	93.10
7	FOOD & FOOD PROD	3	135.49	.12	37.50
8	PULP,PAPER & PROD	10	436.98	.12	47.00
9	CHEMICALS & PROD	4	174.78	.12	70.30
10	PETROLEUM PROD	2	168.16	.12	54.50
11	S,C,G,C	8	64.42	.12	94.00
12	PRIMARY METALS	5	490.33	.12	426.00
13	FABRICATED METALS	5	463.51	.12	483.60
14	MISCELLANEOUS	10	53.98	.12	148.00
15	CRUDE PETROLEUM	7	133.21	.12	54.00

TABLE 3

TRANSPORTATION CLASS CHARACTERISTICS

TRANSPORTATION CLASS	HANDLING CLASS	BARGE TYPE	ANNUAL KTONS
1 COAL & METALLIC MIN.	1	2	53618
2 PETRO PROD-SUPER TAN	3	4	19016
3 FARM & FOOD PROD	1	3	9107
4 CHEM PROD-JUMBO TANK	3	5	12319
5 IRON & STEEL & FE	2	2	3669
6 REGULAR BARGE	1	1	0
7 CRUDE PETRO-JUMBO TN	3	6	4807
8 S,C,G,C-NONMETAL MIN	1	2	18330
9 NOT USED	1	2	0
10 FOREST & PAPER PROD	1	2	5592

TABLE 4

TOWBOAT CHARACTERISTICS

	TOWBOAT CLASS	HORSE-POWER	MAX TOW SIZE	LENGTH (FT)	BEAM (FT)	DRAFT (FT)	BLOCK COEFF	FUEL CONSUMP. (GAL/HR) OPER.	FUEL CONSUMP. (GAL/HR) MNVR.	LABOR COST ($/HR)	OTHER COST ($/HR)	TOTAL VARIABLE COST ($/HR) OPER.	TOTAL VARIABLE COST ($/HR) MNVR.	ANNUAL FIXED COST ($)	AVAILA-BILITY FACTOR
1	1800 BHP TOWBOAT	1530	6	85	35	7.2	.75	64.0	37.0	41.40	20.50	125.90	98.90	352000	.95
2	1800 BHP TOWBOAT	1530	8	85	35	7.2	.75	64.0	37.0	41.40	20.50	125.90	98.90	352000	.95
3	3100 SHP TOWBOAT	2950	13	141	35	7.8	.75	123.0	72.0	44.80	28.50	196.30	145.30	664000	.95
4	4200 SHP TOWBOAT	4000	15	151	40	7.9	.75	167.0	97.0	44.80	35.20	247.00	177.00	822000	.95
5	6550 SHP TOWBOAT	6200	26	185	53	8.8	.75	258.0	151.0	53.80	44.30	356.10	249.10	1056000	.95

TABLE 5

BARGE CHARACTERISTICS

	BARGE CLASS	CAPACITY (TONS)	LENGTH (FT)	BEAM (FT)	DRAFT (FT) EMPTY	DRAFT (FT) LOADED	CLEAR. (FT)	BLOCK COEFF	VAR. COST ($/HR)	FIXED COST ($/YEAR)	AVAIL. FACTOR	SUBSTITUTABLE BARGE CLASSES
1	OPEN HOPPER REGULAR	1070	175	26	1.5	9.5	1.0	.94	1.01	42000	.95	2 3
2	OPEN HOPPER JUMBO	1620	195	35	1.5	9.5	1.0	.94	1.17	52400	.95	1 3
3	COVERED HOPPER	1620	195	35	1.5	9.5	1.0	.94	1.26	59500	.95	
4	PETRO TANK-SUPER	3260	275	50	1.5	9.5	1.0	.94	5.26	179000	.95	6
5	CHEMICAL TANK	1620	195	35	1.5	9.5	1.0	.94	2.88	85900	.95	
6	PETRO TANK-JUMBO	1620	195	35	1.5	9.5	1.0	.94	2.88	85900	.95	4

NOTE: NOMINAL BARGE IS CLASS 2

TABLE 6

PORT CHARACTERISTICS

	PORT	FLT PT.	FLEETING MIN+MIN/BRG		LOADING (MIN/TON) HC1	HC2	HC3	UNLOADING (MIN/TON) HC1	HC2	HC3	PORT DELAY (HR) HC1	HC2	HC3	AVG WAIT FOR TOW (HR/BRG) TC1	TC2	TC3	TC4	TC5
1	APE UPPER MON RIVER		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
2	740 MON R POOL 7		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
3	735 MAXWELL POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
4	730 MON R POOL 4		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
5	725 MON R POOL 3		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
6	715 CLARITON/ELIZAB	*	20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
7	APE PITTSBURGH-MON		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
8	APE ALLEGHENY RIVER		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
9	286 PITTSBURGH-OHIO		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
10	282 DASHIELDS POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
11	APE MONTGOMERY POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
12	274 NEW CUMBERLAND		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
13	272 PIKE ISLAND		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
14	APE HANNIBAL POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
15	APE WILLOW IS POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
16	APE BELLEVILLE POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.80 4.80	4.80 4.80	4.80 4.80	4.80 4.80	4.80 4.80
17	APE RACINE POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.80 4.80	4.80 4.80	4.80 4.80	4.80 4.80	4.80 4.80
18	815 LONDON POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.80 4.80	4.80 4.80	4.80 4.80	4.80 4.80	4.80 4.80
19	810 MARMET POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.80 4.80	4.80 4.80	4.80 4.80	4.80 4.80	4.80 4.80
20	805 WINFIELD POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.80 4.80	4.80 4.80	4.80 4.80	4.80 4.80	4.80 4.80
21	800 LOWER KANAWHA	*	20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.80 4.80	4.80 4.80	4.80 4.80	4.80 4.80	4.80 4.80
22	250 GALLIPOLIS POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.80 4.80	4.80 4.80	4.80 4.80	4.80 4.80	4.80 4.80
23	APE GREENUP POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.80 4.80	4.80 4.80	4.80 4.80	4.80 4.80	4.80 4.80

TABLE 6 (Contd)
PORT CHARACTERISTICS

	PORT	FLT PT.	FLEETING MIN+	MIN/BRG	LOADING (MIN/TON) HC1	HC2	HC3	UNLOADING (MIN/TON) HC1	HC2	HC3	PORT DELAY (HR) HC1	HC2	HC3	AVG WAIT FOR TOW (HR/BRG) TC1	TC2	TC3	TC4	TC5
24	245 BIG SANDY RIVER		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.80 4.80	4.80 4.80	4.80 4.80	4.80 4.80	4.80 4.80
25	242 MELDAHL POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.80 4.80	4.80 4.80	4.80 4.80	4.80 4.80	4.80 4.80
26	APE CINCINNATI AREA		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	5.90 5.90	5.90 5.90	5.90 5.90	5.90 5.90	5.90 5.90
27	APE KENTUCKY RIVER		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	7.60 7.60	7.60 7.60	7.60 7.60	7.60 7.60	7.60 7.60
28	APE MCALPINE POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	7.60 7.60	7.60 7.60	7.60 7.60	7.60 7.60	7.60 7.60
29	232 LOUISVLLE UPPER		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	7.60 7.60	7.60 7.60	7.60 7.60	7.60 7.60	7.60 7.60
30	230 LOUISVLLE LOWER		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	7.60 7.60	7.60 7.60	7.60 7.60	7.60 7.60	7.60 7.60
31	228 CANNELTON POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	7.60 7.60	7.60 7.60	7.60 7.60	7.60 7.60	7.60 7.60
32	APE NEWBURGH POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	7.60 7.60	7.60 7.60	7.60 7.60	7.60 7.60	7.60 7.60
33	APE GREEN POOLS 2-3		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	7.60 7.60	7.60 7.60	7.60 7.60	7.60 7.60	7.60 7.60
34	1005 GREEN POOL 1		20	5	.13	1.50	.27	.22	.93	.39	6.	0.	0.	7.60 7.60	7.60 7.60	7.60 7.60	7.50 7.60	7.60 7.60
35	220 EVANSVILLE		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	7.60 7.60	7.60 7.60	7.60 7.60	7.60 7.60	7.60 7.60
36	APE MT. VERNON		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	7.60 7.60	7.60 7.60	7.60 7.60	7.60 7.60	7.60 7.60
37	210 L&D 50 POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	7.60 7.60	7.60 7.60	7.60 7.60	7.60 7.60	7.60 7.60
38	SMITHLAND/51 POOLS		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	7.60 7.60	7.60 7.60	7.60 7.60	7.60 7.60	7.60 7.60
39	APE UPP CUMBERLAND		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
40	1205 BARKLEY POOL		20	5	.13	1.50	.27	.22	.92	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
41	APE UPP TENN-CLINCH		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
42	1355 CHICKMAUGA POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
43	APE CHATTANOOGA TN	*	20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
44	APE GUNTERSVILLE PL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
45	1320 WHEELER POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 [illegible]	4.40 [illegible]	4.40 [illegible]	4.40 4.40	4.40 [illegible]
46	1315 WILSON POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40

TABLE 6 (Contd)

PORT CHARACTERISTICS

	PORT	FLT PT.	FLEETING MIN+	MIN/BRG	LOADING (MIN/TON) HC1	HC2	HC3	UNLOADING (MIN/TON) HC1	HC2	HC3	PORT DELAY (HR) HC1	HC2	HC3	AVG WAIT FOR TOW (HR/BRG) TC1	TC2	TC3	TC4	TC5
47	1310 PICKWICK POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
48	APE TENN R/TTW FLTG	*	20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
49	1305 KENTUCKY LAKE 2		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
50	1303 KENTUCKY LAKE 1		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
51	APE LOWER TENN-CUMB		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
52	204 L&D 52 POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	3.10 3.10	3.10 3.10	3.10 3.10	3.10 3.10	3.10 3.10
53	202 L&D 53 POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	3.10 3.10	3.10 3.10	3.10 3.10	3.10 3.10	3.10 3.10
54	APE MINN-ST. PAUL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
55	APE MISS POOLS 4-5A		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
56	APE LA CROSSE AREA		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
57	APE DAVNPRT-RK ISLD		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
58	APE POOLS 20-25		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
59	APE CHICAGO AREA		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
60	APE JOLIET AREA		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
61	APE LOWR ILLINOIS R		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
62	APE MISS R POOL 26	*	20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
63	APE OMAHA AREA		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
64	APE KANSAS CITY		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40	4.40 4.40
65	302 ST. LOUIS		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
66	APE MISS R(OHIO-27)		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
67	200 OHIO R BELOW 53	*	20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	3.10 3.10	3.10 3.10	3.10 3.10	3.10 3.10	3.10 3.10
68	APE MEMPHIS AREA		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	3.10 3.10	3.10 3.10	3.10 3.10	3.10 3.10	3.10 3.10
69	APE TULSA AREA		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	12.00 12.00	12.00 12.00	12.00 12.00	12.00 12.00	12.00 12.00

TABLE 6 (Contd)

PORT CHARACTERISTICS

	PORT	FLT PT.	FLEETING MIN+MIN/BRG		LOADING (MIN/TON) HC1	HC2	HC3	UNLOADING (MIN/TON) HC1	HC2	HC3	PORT DELAY (HR) HC1	HC2	HC3	AVG WAIT FOR TOW (HR/BRG) TC1	TC2	TC3	TC4	TC5
70	APE LITTLE ROCK		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	12.00 12.00	12.00 12.00	12.00 12.00	12.00 12.00	12.00 12.00
71	APE MISS-ARK R JCT		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	3.10 3.10	3.10 3.10	3.10 3.10	3.10 3.10	3.10 3.10
72	APE VICKSBURG AREA		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	3.10 3.10	3.10 3.10	3.10 3.10	3.10 3.10	3.10 3.10
73	APE BATON ROUGE		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	3.10 3.10	3.10 3.10	3.10 3.10	3.10 3.10	3.10 3.10
74	APE CORPUS CHRISTI		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
75	APE HOUSTON AREA		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
76	APE PORT ARTHUR		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
77	APE MORGAN CITY		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
78	CORP CHRIS VIA TTW		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
79	HOUSTON VIA TWW		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
80	PORT ARTHUR VIA TWW		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
81	MORGAN CITY VIA TWW		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
82	APE E TERMINUS GIWW		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
83	2610 PENSACOLA FLA		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
84	APE MOBILE AREA	*	20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
85	APE MIDDLE GIWW		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
86	IHNC-NEW ORLEANS		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	5.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
87	JCT AT IHNC LK	*	20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
88	APE NEW ORLEANS	*	20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	3.10 3.10	3.10 3.10	3.10 3.10	3.10 3.10	3.10 3.10
89	E TERM GIWW VIA MISS		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
90	PENSACOLA VIA MISS		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
91	MOBILE VIA MISS R		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00
92	MID-GIWW VIA MISS R		20	5	.13	1.50	.27	.22	.33	.39	0.	0.	0.	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00	6.00 6.00

TABLE 6 (Contd)

PORT CHARACTERISTICS

	PORT	FLT PT.	FLEETING MIN+MIN/BRG		LOADING (MIN/TON) HC1	HC2	HC3	UNLOADING (MIN/TON) HC1	HC2	HC3	PORT DELAY (HR) HC1	HC2	HC3	AVG WAIT FOR TOW (HR/BRG) TC1	TC2	TC3	TC4	TC5
93	IHNC VIA MISS R		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00	6.00	6.00	6.00	6.00
														6.00	6.00	6.00	6.00	6.00
94	ABERDEEN TTW CUT		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00	6.00	6.00	6.00	6.00
														6.00	6.00	6.00	6.00	6.00
95	COLUMBUS POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00	6.00	6.00	6.00	6.00
														6.00	6.00	6.00	6.00	6.00
96	ALICEVILLE POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00	6.00	6.00	6.00	6.00
														6.00	6.00	6.00	6.00	6.00
97	GAINSVILLE POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00	6.00	6.00	6.00	6.00
														6.00	6.00	6.00	6.00	6.00
98	BANKHEAD POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00	6.00	6.00	6.00	6.00
														6.00	6.00	6.00	6.00	6.00
99	HOLT POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00	6.00	6.00	6.00	6.00
														6.00	6.00	6.00	6.00	6.00
100	OLIV R POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00	6.00	6.00	6.00	6.00
														6.00	6.00	6.00	6.00	6.00
101	WARRIOR POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00	6.00	6.00	6.00	6.00
														6.00	6.00	6.00	6.00	6.00
102	DEMOPOLIS POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00	6.00	6.00	6.00	6.00
														6.00	6.00	6.00	6.00	6.00
103	COFFEVILLE POOL		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00	6.00	6.00	6.00	6.00
														6.00	6.00	6.00	6.00	6.00
104	APE ALABAMA-COOSA R		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00	6.00	6.00	6.00	6.00
														6.00	6.00	6.00	6.00	6.00
105	MOBILE RIVER		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00	6.00	6.00	6.00	6.00
														6.00	6.00	6.00	6.00	6.00
106	ARKANSAS R FLEETING	*	20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	12.00	12.00	12.00	12.00	12.00
														12.00	12.00	12.00	12.00	12.00
107	GREEN RIVER FLEETNG	*	20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	7.60	7.60	7.60	7.60	7.60
														7.60	7.60	7.60	7.60	7.60
108	TENN/OHIO D/S FLEET		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	3.10	3.10	3.10	3.10	3.10
														3.10	3.10	3.10	3.10	3.10
109	TTW/TENN D/S FLEET	*	20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00	6.00	6.00	6.00	6.00
														6.00	6.00	6.00	6.00	6.00
110	ALABAMA R FLEETING		20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00	6.00	6.00	6.00	6.00
														6.00	6.00	6.00	6.00	6.00
111	TTW/BLCK WARR FLEET	*	20	5	.13	1.50	.27	.22	.93	.39	0.	0.	0.	6.00	6.00	6.00	6.00	6.00
														6.00	6.00	6.00	6.00	6.00

TABLE 7

LOCK CHARACTERISTICS

	LOCK	MAIN CHAMBER CLASS		MAIN CHAMBER AVAIL	MAIN CHAMBER SHARE	AUXILLARY CHAMBER CLASS	AUXILLARY CHAMBER AVAIL	AUXILLARY CHAMBER SHARE	LOCKAGE FEE ($)	KTONS/YEAR UPSTR.	KTONS/YEAR DNSTR.	BARGES /YEAR	AVG DELAY (HOURS)
1	LOCK & DAM 53 (OHIO)	1	1200 X 110	.95	1.00					29355	31062	77331	.33
2	LOCK & DAM 52 (OHIO)	2	1200 X 110	.95	1.00					34788	35960	85108	2.60
3	SMITHLAND L&D	3	1200 X 110	.95	1.00					25892	42500	89733	.69
4	IHNC LOCK	4	640 X 75	.95	1.00					9339	11717	29650	4.61
5	CHEATHAM L&D	5	600 X 110	.95	1.00					2892	187	3935	.11
6	KENTUCKY-BARKLEY LKS	6	800 X 110	.95	1.00					26041	5010	43395	2.84
7	PICKWICK L&D	7	600 X 110	.95	1.00					13325	1424	21232	1.11
8	WATTS BAR L&D	8	360 X 60	.95	1.00					289	124	642	.19
9	CHICKAMAUGA L&D	9	360 X 60	.95	1.00					1072	78	1912	.72
10	NICKAJACK L&D	10	600 X 110	.95	1.00					2723	481	4687	.16
11	GUNTERSVILLE L&D	11	600 X 110	.95	1.00					3416	439	5538	.13
12	WHEELER L&D	12	600 X 110	.95	1.00					5892	1133	9370	.27
13	WILSON L&D	13	600 X 110	.95	1.00					6073	1268	9600	.49
14	BAY SPRINGS LOCK	14	600 X 110	.95	1.00					57	39	127	.00
15	LOCK E (TENN-TOM)	15	600 X 110	.95	1.00					57	39	127	.00
16	LOCK D (TENN-TOM)	15	600 X 110	.95	1.00					57	39	127	.00
17	LOCK C (TENN-TOM)	15	600 X 110	.95	1.00					57	39	127	.00
18	LOCK B (TENN-TOM)	15	600 X 110	.95	1.00					57	39	127	.00
19	LOCK A (TENN-TOM)	15	600 X 110	.95	1.00					57	39	127	.00
20	ABERDEEN L&D	15	600 X 110	.95	1.00					57	39	127	.00
21	COLUMBUS L&D	15	600 X 110	.95	1.00					63	39	134	.00
22	ALICEVILLE L&D	15	600 X 110	.95	1.00					65	42	139	.00
23	GAINESVILLE L&D	16	600 X 110	.95	1.00					65	42	139	.00
24	BANKHEAD L&D	19	600 X 110	.95	1.00					3994	5595	8764	.12
25	HOLT L&D	20	600 X 110	.95	1.00					4000	7990	12339	.21
26	OLIVER L&D	21	460 X 95	.95	1.00					4174	8056	12667	.81
27	WARRIOR L&D	22	600 X 110	.95	1.00					4220	8178	12841	.18
28	DEMOPOLIS L&D	17	600 X 110	.95	1.00					4281	7502	11925	.14
29	COFFEEVILLE L&D	18	600 X 110	.95	1.00					4346	7769	12430	.15

TABLE 8

LOCK CHAMBER CHARACTERISTICS

CLASS	LENGTH (FT)	WIDTH (FT)	CAPACITY (BRGS/YR)	DELAY AT 50% CAPACITY(MIN)	AVG. LOCKAGE TIME (MIN) SINGLE	SETOVER	DOUBLE	LOCKAGE TYPE PARAMETERS R1	R2	R3	PS	PL
1	1200	110	423703	84	15	0	0	20.00	1.00	1.00	0.	0.
2	1200	110	305870	377	34	0	0	20.00	1.00	1.00	0.	0.
3	1200	110	223118	56	43	0	0	20.00	1.00	1.00	0.	0.
4	640	75	36521	47	31	0	0	20.00	1.00	1.00	0.	0.
5	600	110	54282	77	50	0	0	20.00	1.00	1.00	0.	0.
6	800	110	87776	157	100	0	0	20.00	1.00	1.00	0.	0.
7	600	110	48395	77	105	0	0	20.00	1.00	1.00	0.	0.
8	360	60	7443	116	285	0	0	20.00	1.00	1.00	0.	0.
9	360	60	7443	116	285	0	0	20.00	1.00	1.00	0.	0.
10	600	110	43941	77	59	0	0	20.00	1.00	1.00	0.	0.
11	600	110	62468	77	75	0	0	20.00	1.00	1.00	0.	0.
12	600	110	57248	77	132	0	0	20.00	1.00	1.00	0.	0.
13	600	110	42556	95	172	0	0	20.00	1.00	1.00	0.	0.
14	600	110	67568	40	40	0	0	20.00	1.00	1.00	0.	0.
15	600	110	67568	37	37	0	0	20.00	1.00	1.00	0.	0.
16	600	110	67568	36	35	0	0	20.00	1.00	1.00	0.	0.
17	600	110	60248	33	39	0	0	20.00	1.00	1.00	0.	0.
18	600	110	58671	32	39	0	0	20.00	1.00	1.00	0.	0.
19	600	110	39527	24	49	0	0	20.00	1.00	1.00	0.	0.
20	600	110	54166	40	41	0	0	20.00	1.00	1.00	0.	0.
21	460	95	28716	56	80	0	0	20.00	1.00	1.00	0.	0.
22	600	110	61149	37	41	0	0	20.00	1.00	1.00	0.	0.
23	600	110	1	0	1	0	0	20.00	1.00	1.00	0.	0.
24	600	110	1	0	1	0	0	20.00	1.00	1.00	0.	0.
25	1200	110	1	0	1	0	0	20.00	1.00	1.00	0.	0.
26	600	110	1	0	1	0	0	20.00	1.00	1.00	0.	0.
27	600	110	103140	116	101	0	0	20.00	1.00	1.00	0.	0.
28	600	110	1	0	1	0	0	20.00	1.00	1.00	0.	0.
29	360	60	1	0	1	0	0	20.00	1.00	1.00	0.	0.
30	400	60	1	0	1	0	0	20.00	1.00	1.00	0.	0.
31	292	42	1	0	1	0	0	20.00	1.00	1.00	0.	0.

TABLE 9

LOCKS

LOCK	CHAMBER SIZE	OPER. POLICY	MULTI-TOW OPTION	READY-TO-SERVE OPTION	SIMPLE TIME CALC.	DETAILED STATS.	SETOVER PROB.	AVG DELAY (HR)	CHMBR SELECT BIAS	RECRE-ATIONAL TRAFFIC	OPEN PASS
SECTOR 9 OHIO RIVER											
1 SMITHLAND L&D								0.	0	NO	NO
CHAMBER 1	1200 X 110	F	NO	NO	YES	NO	0.				
CHAMBER 2	1200 X 110	F	NO	NO	YES	NO	0.				
SECTOR 15 LOWER OHIO RIVER											
1 LOCK & DAM 52 (OHIO)								0.	0	NO	NO
CHAMBER 1	1200 X 110	F	NO	NO	YES	NO	0.				
CHAMBER 2	600 X 110	F	NO	NO	YES	NO	0.				
2 LOCK & DAM 53 (OHIO)								0.	0	NO	NO
CHAMBER 1	1200 X 110	F	NO	NO	YES	NO	0.				
CHAMBER 2	600 X 110	F	NO	NO	YES	NO	0.				
SECTOR 13 LOWER TENNESSEE R											
1 PICKWICK L&D	600 X 110	F	NO	NO	YES	NO	0.	0.	0	NO	NO
SECTOR 14 LOWER TENN-CUMBERLND											
1 KENTUCKY-BARKLEY LKS								0.	99	NO	NO
CHAMBER 1	600 X 110	F	NO	NO	NO	YES	11.500				
CHAMBER 2	600 X 110	F	NO	NO	NO	YES	2.500				
SECTOR 11 UPPER TENNESSEE R											
1 WATTS BAR L&D	360 X 60	F	NO	NO	YES	NO	0.	0.	0	NO	NO
2 CHICKAMAUGA L&D	360 X 60	F	NO	NO	YES	YES	0.	0.	0	NO	NO
SECTOR 12 MIDDLE TENNESSEE R											
1 NICKAJACK L&D	600 X 110	F	NO	NO	YES	NO	0.	0.	0	NO	NO
2 GUNTERSVILLE L&D								0.	0	NO	NO
CHAMBER 1	600 X 110	F	NO	NO	YES	NO	0.				
CHAMBER 2	360 X 60	F	NO	NO	YES	NO	0.				
3 WHEELER L&D								0.	0	NO	NO
CHAMBER 1	600 X 110	F	NO	NO	YES	NO	0.				
CHAMBER 2	400 X 60	F	NO	NO	YES	NO	0.				

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TABLE 9 (Contd)

LOCKS

LOCK	CHAMBER SIZE	OPER. POLICY	MULTI-TOW OPTION	READY-TO-SERVE OPTION	SIMPLE TIME CALC.	DETAILED STATS.	SETOVER PROB.	AVG DELAY (HR)	CHMBR SELECT BIAS	RECRE-ATIONAL TRAFFIC	OPEN PASS
4 WILSON L&D								0.	0	NO	NO
CHAMBER 1	600 X 110	F	NO	NO	YES	NO	0.				
CHAMBER 2	292 X 42	F	NO	NO	YES	NO	0.				
SECTOR 10 CUMBERLAND RIVER											
1 CHEATHAM L&D	600 X 110	F	NO	NO	YES	NO	0.	0.	0	NO	NO
SECTOR 32 INNER HARBOR NAV CAN											
1 IHNC LOCK	640 X 75	F	YES	NO	NO	YES	3.300	0.	0	YES	NO
SECTOR 28 LOWR TOMBIGBEE											
1 DEMOPOLIS L&D	600 X 110	N 1	NO	NO	NO	YES	.300	0.	0	NO	NO
2 COFFEEVILLE L&D	600 X 110	N 1	NO	NO	NO	YES	.200	0.	0	NO	NO
SECTOR 27 BLACK WARRIOR RIVER											
1 BANK. AD L&D	600 X 110	F	NO	NO	YES	NO	0.	0.	0	NO	NO
2 HOLT L&D	600 X 110	F	NO	NO	YES	NO	0.	0.	0	NO	NO
3 OLIVER L&D	500 X 95	F	NO	NO	NO	YES	5.200	0.	0	NO	NO
4 WARRIOR L&D	600 X 110	F	NO	NO	YES	NO	0.	0.	0	NO	NO
SECTOR 26 TENNESSEE-TOMBIGBEE											
1 BAY SPRINGS LOCK	600 X 110	F	NO	NO	YES	NO	0.	0.	0	NO	NO
2 LOCK E (TENN-TOM)	600 X 110	F	NO	NO	YES	NO	0.	0.	0	NO	NO
3 LOCK D (TENN-TOM)	600 X 110	F	NO	NO	YES	NO	0.	0.	0	NO	NO
4 LOCK C (TENN-TOM)	600 X 110	F	NO	NO	YES	NO	0.	0.	0	NO	NO
5 LOCK B (TENN-TOM)	600 X 110	F	NO	NO	YES	NO	0.	0.	0	NO	NO
6 LOCK A (TENN-TOM)	600 X 110	F	NO	NO	YES	NO	0.	0.	0	NO	NO
7 ABERDEEN L&D	600 X 110	F	NO	NO	YES	NO	0.	0.	0	NO	NO
8 COLUMBUS L&D	600 X 110	F	NO	NO	YES	NO	0.	0.	0	NO	NO
9 ALICEVILLE L&D	600 X 110	F	NO	NO	YES	NO	0.	0.	0	NO	NO
10 GAINESVILLE L&D	600 X 110	F	NO	NO	YES	NO	0.	0.	0	NO	NO

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TABLE 10

LOCKAGE TIMES I: APPROACH AND ENTRY DISTRIBUTIONS

	------ APPROACH (OR SIMPLIFIED LOCKAGE DISTRIBUTIONS) ------				------ ENTRY ------	
	FLY OR EXCHANGE		TURNBACK			
	UP (*:SINGLE)	DOWN (*:SETOVER)	UP (*:MULTICUT)	DOWN (*:TURNBACK)	LOADED TOW	EMPTY TOW
SECTOR 9						
LOCK 1						
CHAMBER 1	K 43.40*	K 0. *	K 0. *	K 0. *		
CHAMBER 2	K 43.40*	K 0. *	K 0. *	K 0. *		
SECTOR 15						
LOCK 1						
CHAMBER 1	K 34.30*	K 0. *	K 0. *	K 0. *		
CHAMBER 2	K 34.30*	K 0. *	K 0. *	K 0. *		
LOCK 2						
CHAMBER 1	K 14.80*	K 0. *	K 0. *	K 0. *		
CHAMBER 2	K 14.80*	K 0. *	K 0. *	K 0. *		
SECTOR 13						
LOCK 1	K 39.50*	K 71.70*	K 96.90*	K 16.90*		
SECTOR 14						
LOCK 1						
CHAMBER 1	K 11.40	K 9.90	K 3.60	K 2.90	K 8.00	K 8.00
CHAMBER 2	K 19.20	K 16.70	K 2.70	K 2.00	K 9.60	K 9.60
SECTOR 11						
LOCK 1	K 36.30*	K 77.00*	K 72.10*	K 18.60*		
LOCK 2	K 28.80*	K 0. *	K 63.90*	K 6.50*		
SECTOR 12						
LOCK 1	K 41.40*	K 58.10*	K 94.70*	K 15.40*		
LOCK 2						
CHAMBER 1	K 36.70*	K 58.60*	K100.20*	K 14.70*		
CHAMBER 2	K 30.30*	K 45.00*	K 80.10*	K 13.40*		
LOCK 3						
CHAMBER 1	K 40.70*	K 59.80*	K 92.70*	K 14.20*		
CHAMBER 2	K 32.50*	K 43.60*	K 59.50*	K 13.00*		

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TABLE 10 (Contd)

LOCKAGE TIMES I: APPROACH AND ENTRY DISTRIBUTIONS

	APPROACH (OR SIMPLIFIED LOCKAGE DISTRIBUTIONS)				ENTRY	
	FLY OR EXCHANGE		TURNBACK			
	UP (*:SINGLE)	DOWN (*:SETOVER)	UP (*:MULTICUT)	DOWN (*:TURNBACK)	LOADED TOW	EMPTY TOW
LOCK 4						
CHAMBER 1	K 53.00*	K 66.10*	K112.60*	K 23.40*		
CHAMBER 2	K 62.20*	K 0. *	K 91.10*	K 10.10*		
SECTOR 10						
LOCK 1	K 41.40*	K 65.70*	K 99.40*	K 16.60*		
SECTOR 32						
LOCK 1	K 10.40	K 9.90	K 5.80	K 6.80	K 8.00	K 8.00
SECTOR 28						
LOCK 1	K 10.70	K 11.00	K 6.80	K 8.30	K 5.00	K 5.00
LOCK 2	K 9.30	K 10.40	K 4.20	K 5.20	K 4.80	K 4.80
SECTOR 27						
LOCK 1	K 39.90*	K 64.30*	K116.00*	K 15.90*		
LOCK 2	K 46.90*	K 74.00*	K 72.40*	K 13.00*		
LOCK 3	K 8.80	K 12.40	K 4.40	K 4.20	K 6.90	K 6.90
LOCK 4	K 40.20*	K 56.20*	K 83.40*	K 15.10*		
SECTOR 26						
LOCK 1	K 35.50*	K 47.50*	K 0. *	K 6.50*		
LOCK 2	K 37.00*	K 49.00*	K 0. *	K 8.00*		
LOCK 3	K 37.00*	K 49.00*	K 0. *	K 8.00*		
LOCK 4	K 37.00*	K 49.00*	K 0. *	K 8.00*		
LOCK 5	K 37.00*	K 49.00*	K 0. *	K 8.00*		
LOCK 6	K 37.00*	K 49.00*	K 0. *	K 8.00*		
LOCK 7	K 37.00*	K 49.00*	K 0. *	K 8.00*		
LOCK 8	K 37.00*	K 49.00*	K 0. *	K 8.00*		
LOCK 9	K 37.00*	K 49.00*	K 0. *	K 8.00*		
LOCK 10	K 40.00*	K 52.00*	K 0. *	K 11.00*		

TABLE 10 (Contd)

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LOCKAGE TIMES II: CHAMBERING AND EXIT DISTRIBUTIONS

	CHAMBERING		EXIT			
			FLY OR EXCHANGE		TURNBACK	
	UPSTREAM	DOWNSTREAM	UPSTREAM	DOWNSTREAM	UPSTREAM	DOWNSTREAM
SECTOR 5						
LOCK 1						
CHAMBER 1						
CHAMBER 2						
SECTOR 15						
LOCK 1						
CHAMBER 1						
CHAMBER 2						
LOCK 2						
CHAMBER 1						
CHAMBER 2						
SECTOR 13						
LOCK 1						
SECTOR 14						
LOCK 1						
CHAMBER 1	K 10.00	K 10.00	K 7.70	K 9.00	K 7.60	K 6.80
CHAMBER 2	K 17.90	K 17.50	K 8.70	K 7.90	K 9.30	K 6.50
SECTOR 11						
LOCK 1						
LOCK 2						
SECTOR 12						
LOCK 1						
LOCK 2						
CHAMBER 1						
CHAMBER 2						
LOCK 3						
CHAMBER 1						
CHAMBER 2						

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TABLE 10 (Contd)

LOCKAGE TIMES II: CHAMBERING AND EXIT DISTRIBUTIONS

	CHAMBERING		EXIT			
			FLY OR EXCHANGE		TURNBACK	
	UPSTREAM	DOWNSTREAM	UPSTREAM	DOWNSTREAM	UPSTREAM	DOWNSTREAM
LOCK 4						
CHAMBER 1						
CHAMBER 2						
SECTOR 10						
LOCK 1						
SECTOR 32						
LOCK ·	K 7.00	K 7.00	K 8.20	K 5.20	K 8.50	K 5.90
SECTOR 28						
LOCK 1	K 11.00	K 11.00	K 9.40	K 10.10	K 5.60	K 6.00
LOCK 2	K 10.50	K 16.90	K 8.20	K 9.20	K 6.90	K 6.50
SECTOR 27						
LOCK 1						
LOCK 2						
LOCK 3	K 13.90	K 14.10	K 8.10	K 9.00	K 5.50	K 6.30
LOCK 4						
SECTOR 26						
LOCK 1						
LOCK 2						
LOCK 3						
LOCK 4						
LOCK 5						
LOCK 6						
LOCK 7						
LOCK 8						
LOCK 9						
LOCK 10						

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TABLE 10 (Contd)

LOCKAGE TIMES III: MISCELLANEOUS DISTRIBUTIONS

	EXTRA TIME FOR SETOVER	MULTICUT, EXTRA TIME PER CUT	LIGHT BOAT ENTRY/EXIT
SECTOR 9			
LOCK 1			
CHAMBER 1			
CHAMBER 2			
SECTOR 15			
LOCK 1			
CHAMBER 1			
CHAMBER 2			
LOCK 2			
CHAMBER 1			
CHAMBER 2			
SECTOR 13			
LOCK 1			
SECTOR 14			
LOCK 1			
CHAMBER 1	K 26.50	K 99.70	K 11.10
CHAMBER 2	K 20.50	K103.90	K 16.40
SECTOR 11			
LOCK 1			
LOCK 2			
SECTOR 12			
LOCK 1			
LOCK 2			
CHAMBER 1			
CHAMBER 2			
LOCK 3			
CHAMBER 1			
CHAMBER 2			

TABLE 10 (Contd)

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LOCKAGE TIMES III: MISCELLANEOUS DISTRIBUTIONS

	EXTRA TIME FOR SETOVER	MULTICUT, EXTRA TIME PER CUT	LIGHT BOAT ENTRY/EXIT
LOCK 4			
CHAMBER 1			
CHAMBER 2			
SECTOR 10			
LOCK 1			
SECTOR 32			
LOCK 1	K 13.70	K 41.10	K 8.60
SECTOR 28			
LOCK 1	K 11.80	K 0.	K 20.60
LOCK 2	K 16.40	K 0.	K 9.80
SECTOR 27			
LOCK 1			
LOCK 2			
LOCK 3	K 10.00	K 61.30	K 11.60
LOCK 4			
SECTOR 26			
LOCK 1			
LOCK 2			
LOCK 3			
LOCK 4			
LOCK 5			
LOCK 6			
LOCK 7			
LOCK 8			
LOCK 9			
LOCK 10			

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TABLE 10 (Contd)

LOCKAGE TIMES V: RECREATIONAL TRAFFIC

	VESSELS PER DAY				MAXIMUM WAIT (LOCKAGES)	ENTRY/EXIT TIME	
	WEEKDAY UP	WEEKDAY DOWN	WEEKEND UP	WEEKEND DOWN		FIRST VESSEL	FOLLOWING VESSELS
SECTOR 32							
LOCK 1	4	5	4	5	3	K 0.60	K 1.00

TABLE 11

RIVER SEGMENT DATA

	RIVER SEGMENT	LENGTH (MI)	NUMBER LOCKS	------ O&M EXPENDITURES ($1000) ------ LOCKS	OTHER COE	COAST GD	TOTAL	IMPLEMENTATION EXPENDITURES	TOTAL GOVT. EXPENDITURES	SEGMENT FEE (MILLS/TON-MI)
1	OHIO RIVER	980.8	3	1.0	0.	0.	1.0	0.	1.0	
2	ALABAMA RIVER	230.0	0	1.0	0.	0.	1.0	0.	1.0	
3	MONONGAHELA RIVER	103.5	0	1.0	0.	0.	1.0	0.	1.0	
4	KANAWHA RIVER	86.0	0	1.0	0.	0.	1.0	0.	1.0	
5	KENTUCKY RIVER	67.3	0	1.0	0.	0.	1.0	0.	1.0	
6	TENNESSEE RIVER, LOW	220.0	2	1.0	0.	0.	1.0	0.	1.0	
7	TENNESSEE RIVER, UP	387.6	6	1.0	0.	0.	1.0	0.	1.0	
8	CUMBERLAND RIVER	166.1	1	1.0	0.	0.	1.0	0.	1.0	
9	UPPER MISSISSIPPI	842.2	0	1.0	0.	0.	1.0	0.	1.0	
10	LOWER MISSISSIPPI	852.0	0	1.0	0.	0.	1.0	0.	1.0	
11	MISSOURI RIVER	696.0	0	1.0	0.	0.	1.0	0.	1.0	
12	ILLINOIS WATERWAY	317.0	0	1.0	0.	0.	1.0	0.	1.0	
13	ARKANSAS RIVER	375.0	0	1.0	0.	0.	1.0	0.	1.0	
14	GIWW WEST	1216.0	0	1.0	0.	0.	1.0	0.	1.0	
15	MID GIWW-MOBILE HBR	133.8	1	1.0	0.	0.	1.0	0.	1.0	
16	GIWW EAST	598.4	0	1.0	0.	0.	1.0	0.	1.0	
17	MOBILE & TOMBIGBEE R	243.5	2	1.0	0.	0.	1.0	0.	1.0	
18	BLACK WARRIOR RIVER	173.2	4	1.0	0.	0.	1.0	0.	1.0	
19	TENN-TOM WATERWAY	232.2	10	1.0	0.	0.	1.0	0.	1.0	
20	GREEN-BARREN RIVERS	87.3	0	1.0	0.	0.	1.0	0.	1.0	
	TOTAL	7973.9	29	20.0	0.	0.	20.0	0.	20.0	

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TABLE 12

WATERWAY NETWORK - RIVER POINTS, REACHES, AND BENDS

RIVER POINTS				REACH OR BEND	LENGTH (MI)	DEPTH (FT) AVG	DEPTH (FT) MIN	CURRENT (MPH)	COEFFICIENTS UP	COEFFICIENTS DN	COEFFICIENTS FL	BEND RADIUS (FT)	BEND WIDTH (FT)	CLEARANCE WIDTH (FT)	FLANKING LENGTH (FT)
RIVER SYSTEM 1 OHIO RIVER (1)															
SECTOR 3 OHIO RIVER															
0.	PORT	1	286 PITTSBURGH-OHIO	R- 1	7.0	18.0	10.0	.7	.66	.66					
7.0	PORT	2	282 DASHIELDS POOL	R- 2	14.0	14.6	12.0	.7	.66	.66					
21.0	PORT	3	APE MONTGOMERY POOL	R- 3	22.1	22.0	12.0	.8	.66	.66					
43.1	PORT	4	274 NEW CUMBERLAND	R- 4	26.3	18.0	12.0	.8	.66	.66					
69.4	PORT	5	272 PIKE ISLAND	R- 5	35.6	18.0	12.0	.9	.66	.66					
105.0	PORT	6	APE HANNIBAL POOL	R- 6	39.4	21.0	11.0	.9	.66	.66					
144.4	PORT	7	APE WILLOW IS POOL	R- 7	37.4	24.1	11.0	1.0	.66	.66					
181.8	PORT	8	APE BELLEVILLE POOL	R- 8	39.7	36.8	11.0	1.1	.66	.66					
221.5	PORT	9	APE RACINE POOL	R- 9	44.9	44.8	19.5	1.2	.66	.66					
266.4	PORT	10	250 GALLIPOLIS POOL												
SECTOR 5 OHIO RIVER															
0.	PORT	1	250 GALLIPOLIS POOL	R- 1	44.4	41.4	21.8	1.4	.78	.78					
44.4	PORT	2	APE GREENUP POOL	R- 2	7.1	41.4	21.8	1.4	.78	.78					
51.5	PORT	3	245 BIG SANDY RIVER	R- 3	87.4	19.5	9.9	1.7	.78	.78					
138.9	PORT	4	242 MELDAHL POOL	R- 4	66.5	19.0	12.6	1.9	.78	.78					
205.4	PORT	5	APE CINCINNATI AREA	R- 5	74.8	16.0	12.6	1.9	.78	.78					
280.2	PORT	6	APE MCALPINE POOL												
SECTOR 7 OHIO RIVER															
0.	PORT	1	APE MCALPINE POOL	R- 1	58.2	24.0	19.0	1.9	.76	.76					
58.2	PORT	2	232 LOUISVLLE UPPER	R- 2	5.0	13.0	10.6	2.0	.76	.76					
63.2	PORT	3	230 LOUISVLLE LOWER	R- 3	59.0	23.0	12.6	1.5	.76	.76					
122.2	PORT	4	228 CANNELTON POOL	R- 4	90.7	25.0	12.6	1.0	.76	.76					
212.9	PORT	5	APE NEWBURGH POOL	R- 5	25.7	15.0	10.1	.7	.76	.76					
238.6	PORT	6	GREEN RIVER FLEETNG												
SECTOR 9 OHIO RIVER															
0.	PORT	1	220 EVANSVILLE	R- 1	43.6	28.0	11.5	1.1	.79	.79					
43.6	PORT	2	APE MT. VERNON	R- 2	30.0	25.0	11.5	1.6	.79	.79					
73.6	PORT	3	210 L&D 50 POOL	R- 3	32.0	28.0	11.5	1.5	.79	.79					
105.6	PORT	4	SMITHLAND/51 POOLS	R- 4	14.3	40.0	11.5	1.5	.79	.79					
119.9	LOCK	1	SMITHLAND L&D	R- 5	28.7	25.0	11.5	1.4	.79	.79					
148.6	PORT	5	204 L&D 52 POOL												

TABLE 12 (Contd)

WATERWAY NETWORK - RIVER POINTS, REACHES, AND BENDS

RIVER POINTS				REACH OR BEND	LENGTH (MI)	DEPTH (FT) AVG	DEPTH (FT) MIN	CURRENT (MPH)	COEFFICIENTS UP	COEFFICIENTS DN	COEFFICIENTS FL	BEND RADIUS (FT)	BEND WIDTH (FT)	CLEARANCE WIDTH (FT)	FLANKING LENGTH (FT)
SECTOR 15 LOWER OHIO RIVER															
0.	PORT	1	TENN/OHIO D/S FLEET	R- 1	4.4	17.0	11.0	1.6	.79	.79					
4.4	LOCK	1	LOCK & DAM 52 (OHIO)	R- 2	12.1	17.0	11.0	1.9	.79	.79					
16.5	PORT	2	202 L&D 53 POOL	R- 3	11.6	17.0	11.0	1.5	.79	.79					
28.1	LOCK	2	LOCK & DAM 53 (OHIO)	R- 4	18.9	15.0	11.0	1.5	.79	.79					
47.0	PORT	3	200 OHIO R BELOW 53												
RIVER SYSTEM 2 ALABAMA RIVER (2)															
SECTOR 29 ALABAMA RIVER															
0.	PORT	1	APE ALABAMA-COOSA R	R- 1	230.0	10.5	10.5	1.5	.80	.80					
230.0	PORT	2	ALABAMA R FLEETING												
RIVER SYSTEM 3 MONONGAHELA RIVER (3)															
SECTOR 1 MONONGAHELA UPPER															
0.	PORT	1	APE UPPER MON RIVER	R- 1	12.9	11.0	10.0	.4	.68	.68					
12.9	PORT	2	740 MON R POOL 7	R- 2	14.8	11.0	10.0	.5	.68	.68					
27.7	PORT	3	735 MAXWELL POOL	R- 3	21.7	14.0	11.0	.6	.68	.68					
49.4	PORT	4	730 MON R POOL 4	R- 4	18.7	16.0	11.0	.7	.68	.68					
68.1	PORT	5	725 MON R POOL 3	R- 5	15.9	16.0	9.5	.8	.68	.68					
84.0	PORT	6	715 CLARITON/ELIZAB												
SECTOR 2 MONONGAHELA LOWER															
0.	PORT	1	715 CLARITON/ELIZAB	R- 1	14.0	14.0	11.0	1.1	.68	.68					
14.0	PORT	2	APE PITTSBURGH-MON	R- 2	5.0	14.0	11.0	1.3	.68	.68					
19.0	PORT	3	APE ALLEGHENY RIVER	R- 3	.5	14.0	11.0	1.3	.68	.68					
19.5	PORT	4	286 PITTSBURGH-OHIO												
RIVER SYSTEM 4 KANAWHA RIVER (4)															
SECTOR 4 KANAWHA RIVER															
0.	PORT	1	815 LONDON POOL	R- 1	12.5	24.1	13.8	1.5	.62	.62					
12.5	PORT	2	810 MARMET POOL	R- 2	28.5	20.7	10.5	1.1	.62	.62					
41.0	PORT	3	805 WINFIELD POOL	R- 3	45.0	20.7	9.1	.6	.62	.62					
86.0	PORT	4	800 LOWER KANAWHA												

TABLE 12 (Contd)

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WATERWAY NETWORK - RIVER POINTS, REACHES, AND BENDS

RIVER POINTS				REACH OR BEND	LENGTH (MI)	DEPTH (FT) AVG	DEPTH (FT) MIN	CURRENT (MPH)	COEFFICIENTS UP	COEFFICIENTS DN	COEFFICIENTS FL	BEND RADIUS (FT)	BEND WIDTH (FT)	CLEARANCE WIDTH (FT)	FLANKING LENGTH (FT)
RIVER SYSTEM 5 KENTUCKY RIVER (5)															
SECTOR 6 KENTUCKY RIVER															
0.	PORT	1	APE KENTUCKY RIVER	R- 1	67.3	18.0	6.1	.5	.41	.41					
67.3	PORT	2	APE MCALPINE POOL												
RIVER SYSTEM 6 TENNESSEE RIVER, LOW (6)															
SECTOR 13 LOWER TENNESSEE R															
0.	PORT	1	TTW/TENN D/S FLEET	R- 1	8.4	20.7	11.1	.9	.65	.65					
8.4	LOCK	1	PICKWICK L&D	R- 2	107.0	20.7	11.1	.9	.65	.65					
115.4	PORT	2	1305 KENTUCKY LAKE 2	R- 3	77.6	20.7	11.1	.9	.65	.65					
193.0	PORT	3	1303 KENTUCKY LAKE 1												
SECTOR 14 LOWER TENN-CUMBERLND															
0.	PORT	1	1303 KENTUCKY LAKE 1	R- 1	2.0	17.0	11.0	3.1	.55	.55					
2.0	LOCK	1	KENTUCKY-BARKLEY LKS	R- 2	12.0	17.0	11.0	3.1	.55	.55					
14.0	PORT	2	APE LOWER TENN-CUMB	R- 3	13.0	17.0	11.0	3.1	.55	.55					
27.0	PORT	3	204 L&D 52 POOL												
RIVER SYSTEM 7 TENNESSEE RIVER, UP (7)															
SECTOR 11 UPPER TENNESSEE R															
0.	PORT	1	APE UPP TENN-CLINCH	R- 1	72.5	20.7	9.4	.5	.89	.89					
72.5	LOCK	1	WATTS BAR L&D	R- 2	29.5	20.7	9.4	.5	.89	.89					
102.0	PORT	2	1355 CHICKMAUGA POOL	R- 3	29.4	20.7	9.4	.5	.89	.89					
131.4	LOCK	2	CHICKAMAUGA L&D	R- 4	22.0	20.7	9.4	.5	.89	.89					
153.4	PORT	3	APE CHATTANOOGA TN												
SECTOR 12 MIDDLE TENNESSEE R															
0.	PORT	1	APE CHATTANOOGA TN	R- 1	24.6	20.7	11.1	.5	1.20	1.20					
24.6	LOCK	1	NICKAJACK L&D	R- 2	39.6	20.7	11.1	.5	1.20	1.20					
64.2	PORT	2	APE GUNTERSVILLE PL	R- 3	36.1	20.7	11.1	.5	1.20	1.20					
100.3	LOCK	2	GUNTERSVILLE L&D	R- 4	43.0	20.7	11.1	.5	1.20	1.20					
149.3	PORT	3	1320 WHEELER POOL	R- 5	25.1	20.7	11.1	.5	1.20	1.20					
174.4	LOCK	3	WHEELER L&D	R- 6	14.9	20.7	11.1	.5	1.20	1.20					
189.3	PORT	4	1315 WILSON POOL	R- 7	.6	20.7	11.1	.5	1.20	1.20					
189.9	LOCK	4	WILSON L&D	R- 8	3.4	20.7	11.1	.5	1.20	1.20					

AD-A138 450 INTERIM FEASIBILITY REPORT AND ENVIRONMENTAL IMPACT STATEMENT FOR OLIVER..(U) CORPS OF ENGINEERS MOBILE AL MOBILE DISTRICT DEC 83 COESAM/PDW-83/001

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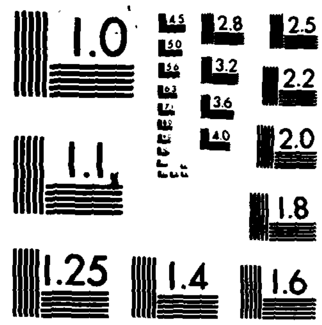

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TABLE 12 (Contd)

WATERWAY NETWORK - RIVER POINTS, REACHES, AND BENDS

RIVER POINTS	REACH OR BEND	LENGTH (MI)	DEPTH (FT) AVG	DEPTH (FT) MIN	CURRENT (MPH)	COEFFICIENTS UP	COEFFICIENTS DN	COEFFICIENTS FL	BEND RADIUS (FT)	BEND WIDTH (FT)	CLEARANCE WIDTH (FT)	FLANKING LENGTH (FT)
193.3 PORT 5 1310 PICKWICK POOL	R- 9	40.9	20.7	11.1	.5	1.20	1.20					
234.2 PORT 6 APE TENN R/TTW FLTG												
RIVER SYSTEM 8 CUMBERLAND RIVER (8)												
SECTOR 10 CUMBERLAND RIVER												
0. PORT 1 APE UPP CUMBERLAND	R- 1	50.0	22.0	11.0	2.2	.96	.96					
50.0 LOCK 1 CHEATHAM L&D	R- 2	45.7	22.0	11.0	2.2	.96	.96					
95.7 PORT 2 1205 BARKLEY POOL	R- 3	70.4	22.0	11.0	2.2	.96	.96					
166.1 PORT 3 1303 KENTUCKY LAKE 1												
RIVER SYSTEM 9 UPPER MISSISSIPPI (9)												
SECTOR 16 UPPR MISS ABVE ILL R												
0. PORT 1 APE MINN-ST. PAUL	R- 1	88.5	12.0	10.5	1.0	.44	.44					
88.5 PORT 2 APE MISS POOLS 4-5A	R- 2	76.8	12.0	10.5	1.0	.44	.44					
165.3 PORT 3 APE LA CROSSE AREA	R- 3	189.0	12.0	10.5	1.0	.44	.44					
354.3 PORT 4 APE DAVNPRT-RK ISLD	R- 4	189.0	12.0	10.5	1.0	.44	.44					
543.3 PORT 5 APE POOLS 20-25	R- 5	81.2	12.0	10.5	1.0	.44	44					
624.5 PORT 6 APE MISS R POOL 26												
SECTOR 18 UP MISS (ILL R-MO R)												
0. PORT 1 APE MISS R POOL 26	R- 1	22.7	13.8	11.0	.6	.19	.19					
22.7 PORT 2 302 ST. LOUIS												
SECTOR 20 UPPR MISS BELOW MO R												
0. PORT 1 302 ST. LOUIS	R- 1	49.0	13.8	11.0	1.9	.44	.44					
49.0 PORT 2 APE MISS R(OHIO-27)	R- 2	146.0	13.8	11.0	.7	.44	.44					
195.0 PORT 3 200 OHIO R BELOW 53												
RIVER SYSTEM 10 LOWER MISSISSIPPI (10)												
SECTOR 21 LOWER MISS ABOVE ARK												
0. PORT 1 200 OHIO R BELOW 53	R- 1	197.0	16.1	11.0	2.0	1.05	1.05					
197.0 PORT 2 APE MEMPHIS AREA	R- 2	175.0	16.1	11.0	2.0	1.05	1.05					
372.0 PORT 3 APE MISS-ARK R JCT												

TABLE 12 (Contd)

WATERWAY NETWORK - RIVER POINTS, REACHES, AND BENDS

RIVER POINTS			REACH OR BEND	LENGTH (MI)	DEPTH (FT) AVG	DEPTH (FT) MIN	CURRENT (MPH)	COEFFICIENTS UP	COEFFICIENTS DN	COEFFICIENTS FL	BEND RADIUS (FT)	BEND WIDTH (FT)	CLEARANCE WIDTH (FT)	FLANKING LENGTH (FT)
SECTOR 23 LOWER MISS BELOW ARK														
0.	PORT 1	APE MISS-ARK R JCT	R- 1	225.0	22.0	18.0	1.5	1.05	1.05					
225.0	PORT 2	APE VICKSBURG AREA	R- 2	121.0	22.0	18.0	1.5	1.05	1.05					
346.0	PORT 3	APE BATON ROUGE	R- 3	134.0	46.0	46.0	1.6	1.05	1.05					
480.0	PORT 4	APE NEW ORLEANS												
RIVER SYSTEM 11 MISSOURI RIVER (11)														
SECTOR 19 MISSOURI RIVER														
0.	PORT 1	APE OMAHA AREA	R- 1	342.0	16.8	9.2	2.2	.75	.75					
342.0	PORT 2	APE KANSAS CITY	R- 2	354.0	16.6	9.2	2.2	.75	.75					
696.0	PORT 3	302 ST. LOUIS												
RIVER SYSTEM 12 ILLINOIS WATERWAY (12)														
SECTOR 17 ILLINOIS WATERWAY														
0.	PORT 1	APE CHICAGO AREA	R- 1	54.0	17.4	11.5	1.0	.52	.52					
54.0	PORT 2	APE JOLIET AREA	R- 2	89.0	17.4	11.5	1.0	.52	.52					
143.0	PORT 3	APE LOWR ILLINOIS R	R- 3	174.0	16.7	10.5	.8	.52	.52					
317.0	PORT 4	APE MISS R POOL 26												
RIVER SYSTEM 13 ARKANSAS RIVER (13)														
SECTOR 22 ARKANSAS WATERWAY														
0.	PORT 1	APE TULSA AREA	R- 1	275.0	10.7	10.5	1.9	.50	.50					
275.0	PORT 2	APE LITTLE ROCK	R- 2	100.0	10.7	10.5	1.9	.50	.50					
375.0	PORT 3	ARKANSAS R FLEETING												
RIVER SYSTEM 14 GIWW WEST (14)														
SECTOR 24 GIWW WEST														
0.	PORT 1	APE CORPUS CHRISTI	R- 1	214.0	13.8	13.8	0.	.80	.80					
214.0	PORT 2	APE HOUSTON AREA	R- 2	118.0	13.8	13.8	0.	.80	.80					
332.0	PORT 3	APE PORT ARTHUR	R- 3	173.0	13.8	13.8	0.	.80	.80					
505.0	PORT 4	APE MORGAN CITY	R- 4	103.0	13.8	13.8	0.	.80	.80					
608.0	PORT 5	APE NEW ORLEANS												

TABLE 12 (Contd)

WATERWAY NETWORK - RIVER POINTS, REACHES, AND BENDS

RIVER POINTS				REACH OR BEND	LENGTH (MI)	DEPTH (FT) AVG	DEPTH (FT) MIN	CURRENT (MPH)	COEFFICIENTS UP	COEFFICIENTS DN	COEFFICIENTS FL	BEND RADIUS (FT)	BEND WIDTH (FT)	CLEARANCE WIDTH (FT)	FLANKING LENGTH (FT)
SECTOR 34 WEST GIWW VIA TN-TOM															
0.	PORT	1	CORP CHRIS VIA TTW	R- 1	214.0	'3.8	13.8	0.	.80	.80					
2:4.0	PORT	2	HOUSTON VIA TWW	R- 2	118.0	13.8	13.8	0.	.80	.80					
332.0	PORT	3	PORT ARTHUR VIA TWW	R- 3	173.0	13.8	13.8	0.	.80	.80					
505.0	PORT	4	MORGAN CITY VIA TWW	R- 4	'03.0	13.8	13.8	0.	.80	.80					
608.0	PORT	5	IHNC-NEW ORLEANS												
RIVER SYSTEM 15 MID GIWW-MOBILE HBR (15)															
SECTOR 31 MID-GIWW & MOBILE															
0.	PORT	1	APE MOBILE AREA	R- 1	46.6	13.8	13.8	0.	.53	.53					
46.6	PORT	2	APE MIDDLE GIWW	R- 2	87.0	13.8	13.8	0.	.53	.53					
133.6	PORT	3	IHNC-NEW ORLEANS												
SECTOR 32 INNER HARBOR NAV CAN															
0.	PORT	1	JCT AT IHNC LK	R- 1	.1	10.5	10.5	1.5	1.00	1.00					
.1	LOCK	1	IHNC LOCK	R- 2	.1	10.5	10.5	1.5	1.00	1.00					
.2	PORT	2	APE NEW ORLEANS												
RIVER SYSTEM 16 GIWW EAST (16)															
SECTOR 25 GIWW EAST															
0.	PORT	1	APE E TERMINUS GIWW	R- 1	166.0	13.8	13.8	0.	.76	.76					
166.0	PORT	2	2610 PENSACOLA FLA	R- 2	46.4	13.8	13.8	0.	.76	.76					
212.4	PORT	3	APE MOBILE AREA												
SECTOR 33 EAST GIWW VIA MISS R															
0.	PORT	1	E TERM GIWW VIA MISS	R- 1	166.0	13.8	13.8	0.	.76	.76					
166.0	PORT	2	PENSACOLA VIA MISS	R- 2	46.4	13.8	13.8	0.	.76	.76					
212.4	PORT	3	MOBILE VIA MISS R	R- 3	46.6	13.8	13.8	0.	.53	.53					
259.0	PORT	4	MID-GIWW VIA MISS R	R- 4	87.0	13.8	13.8	0.	.53	.53					
346.0	PORT	5	IHNC VIA MISS R												
RIVER SYSTEM 17 MOBILE & TOMBIGBEE R (17)															
SECTOR 28 LOWR TOMBIGBEE															
217.0	PORT	1	DEMOPOLIS POOL	R- 1	3.6	11.4	11.4	1.5	1.51	.99					

TABLE 12 (Contd)

WATERWAY NETWORK - RIVER POINTS, REACHES, AND BENDS

RIVER POINTS				REACH OR BEND	LENGTH (MI)	DEPTH (FT) AVG	DEPTH (FT) MIN	CURRENT (MPH)	COEFFICIENTS UP	COEFFICIENTS DN	COEFFICIENTS FL	BEND RADIUS (FT)	BEND WIDTH (FT)	CLEARANCE WIDTH (FT)	FLANKING LENGTH (FT)
213.4	LOCK	1	DEMOPOLIS L&D	R- 2	7.6	15.7	15.7	1.5	1.51	.33					
205.8	TERM	1	BEND TERMINATOR	B- 1	.5	15.5	15.5	1.5	1.25	.78	.20	4900.0	233.0	80.0	800.0
205.3	TERM	2	BEND TERMINATOR	R- 3	.6	16.0	16.0	1.5	1.51	.99					
204.7	TERM	3	BEND TERMINATOR	B- 2	.5	16.4	16.4	1.5	1.16	71	.20	3000.0	256.0	80.0	800.0
204.2	TERM	4	BEND TERMINATOR	R- 4	.5	13.8	13.8	1.5	1.51	.99					
203.7	TERM	5	BEND TERMINATOR	B- 3	.4	14.8	14.8	1.5	1.18	.73	.20	3500.0	290.0	80.0	800.0
203.3	TERM	6	BEND TERMINATOR	R- 5	.2	13.6	13.6	1.5	1.51	.99					
203.1	PORT	2	COFFEVILLE POOL	R- 6	5.1	13.4	13.4	1.5	1.51	.99					
198.0	TERM	7	BEND TERMINATOR	B- 4	.6	12.9	12.9	1.5	.64	.45	.20	2300.0	200.0	80.0	800.0
197.4	TERM	8	BEND TERMINATOR	R- 7	1.1	11.4	11.4	1.5	1.51	.99					
196.3	TERM	9	BEND TERMINATOR	B- 5	.5	13.5	13.5	1.5	1.18	.73	.20	3500.0	350.0	80.0	800.0
195.8	TERM	10	BEND TERMINATOR	R- 8	2.5	13.5	13.5	1.5	1.51	.99					
193.3	TERM	11	BEND TERMINATOR	B- 6	1.2	14.3	14.3	1.5	1.09	.66	.20	1800.0	240.0	80.0	800.0
192.1	TERM	12	BEND TERMINATOR	R- 9	.6	15.0	15.0	1.5	1.51	.99					
191.5	TERM	13	BEND TERMINATOR	B- 7	.9	15.5	15.5	1.5	1.10	.66	.20	1900.0	288.0	80.0	800.0
190.6	TERM	14	BEND TERMINATOR	R- 10	.8	17.0	17.0	1.5	1.51	.99					
189.8	TERM	15	BEND TERMINATOR	B- 8	.5	19.8	19.8	1.5	1.18	.73	.20	3500.0	362.0	80.0	800.0
189.3	TERM	16	BEND TERMINATOR	B- 9	1.0	19.2	19.2	1.5	.45	.33	.20	1500.0	300.0	80.0	800.0
188.3	TERM	17	BEND TERMINATOR	R- 11	1.1	17.0	17.0	1.5	1.51	.99					
187.2	TERM	18	BEND TERMINATOR	B- 10	.5	15.0	15.0	1.5	1.69	.66	.20	1800.0	400.0	[illegible]	800.0
186.7	TERM	19	BEND TERMINATOR	R- 12	.6	14.0	14.0	1.5	1.51	.99					
186.1	TERM	20	BEND TERMINATOR	B- 11	1.1	12.0	12.0	1.5	1.07	.64	.20	1300.0	350.0	80.0	800.0
185.0	TERM	21	BEND TERMINATOR	R- 13	.4	11.5	11.5	1.5	1.51	.99					
184.6	TERM	22	BEND TERMINATOR	B- 12	.8	11.2	11.2	1.5	.66	.47	.20	2400.0	302.0	80.0	800.0
183.8	TERM	23	BEND TERMINATOR	R- 14	.8	16.0	16.0	1.5	1.51	.99					
183.0	TERM	24	BEND TERMINATOR	B- 13	.8	22.3	22.3	1.5	1.13	.68	.20	2400.0	328.0	80.0	800.0
182.2	TERM	25	BEND TERMINATOR	B- 14	1.0	23.0	23.0	1.5	1.08	.64	.20	1500.0	335.0	80.0	800.0
181.2	TERM	26	BEND TERMINATOR	R- 15	.7	20.5	20.5	1.5	1.51	.99					
180.5	TERM	27	BEND TERMINATOR	B- 15	.8	17.7	17.7	1.5	1.05	.62	.20	1000.0	393.0	80.0	800.0
179.7	TERM	28	BEND TERMINATOR	B- 16	1.8	20.2	20.2	1.5	1.07	.64	.20	1400.0	370.0	80.0	800.0
177.9	TERM	29	BEND TERMINATOR	B- 17	.9	23.8	23.8	1.5	1.05	.62	.20	1000.0	400.0	80.0	800.0
177.0	TERM	30	BEND TERMINATOR	R- 16	.6	18.5	18.5	1.5	1.51	.99					
176.4	TERM	31	BEND TERMINATOR	B- 18	.7	21.3	21.3	1.5	1.18	.73	.20	3500.0	335.0	80.0	800.0
175.7	TERM	32	BEND TERMINATOR	B- 19	.6	22.0	22.0	1.5	1.18	.73	.20	3500.0	350.0	80.0	800.0
175.1	TERM	33	BEND TERMINATOR	B- 20	1.0	23.0	23.0	1.5	1.21	.75	.20	4000.0	350.0	80.0	800.0
174.1	TERM	34	BEND TERMINATOR	B- 21	1.1	24.0	24.0	1.5	1.03	.71	.20	4000.0	150.0	80.0	800.0
173.0	TERM	35	BEND TERMINATOR	R- 17	1.7	25.0	25.0	1.5	1.51	.99					
171.3	TERM	36	BEND TERMINATOR	B- 22	.6	26.0	26.0	1.5	.16	.71	.20	3000.0	350.0	80.0	800.0
170.7	TERM	37	BEND TERMINATOR	R- 18	3.9	27.2	27.2	1.5	1.51	.99					
166.8	TERM	38	BEND TERMINATOR	B- 23	.4	32.0	32.0	1.5	1.08	.64	.20	1500.0	353.0	80.0	800.0
166.4	TERM	39	BEND TERMINATOR	B- 24	.9	28.4	28.4	1.5	1.13	.68	.20	2500.0	374.0	80.0	800.0
165.5	TERM	40	BEND TERMINATOR	R- 19	4.1	27.5	27.5	1.5	1.51	.99					
161.4	TERM	41	BEND TERMINATOR	B- 25	.4	23.4	23.4	1.5	1.09	.66	.20	1800.0	366.0	80.0	800.0
161.0	TERM	42	BEND TERMINATOR	R- 20	1.7	25.3	25.3	1.5	1.51	.99					
159.3	TERM	43	BEND TERMINATOR	B- 26	.4	32.1	32.1	1.5	1.07	.64	.20	1400.0	348.0	80.0	800.0
158.9	TERM	44	BEND TERMINATOR	B- 27	1.5	30.4	30.4	1.5	1.26	.79	.20	5000.0	349.0	80.0	800.0

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TABLE 12 (Contd)

WATERWAY NETWORK - RIVER POINTS, REACHES, AND BENDS

RIVER POINTS			REACH OR BEND	LENGTH (MI)	DEPTH (FT) AVG	DEPTH (FT) MIN	CURRENT (MPH)	COEFFICIENTS UP	COEFFICIENTS DN	COEFFICIENTS FL	BEND RADIUS (FT)	BEND WIDTH (FT)	CLEARANCE WIDTH (FT)	FLANKING LENGTH (FT)
157.4	TERM 45	BEND TERMINATOR	R- 21	1.3	24.5	24.5	1.5	1.51	.99					
156.1	TERM 46	BEND TERMINATOR	B- 28	1.0	29.6	29.6	1.5	1.03	.71	.20	4000.0	378.0	80.0	800.0
155.1	TERM 47	BEND TERMINATOR	R- 22	4.3	27.6	27.6	1.5	1.51	.99					
150.8	TERM 48	BEND TERMINATOR	B- 29	1.8	26.6	26.6	1.5	1.05	.62	.20	1000.0	364.0	80.0	800.0
149.0	TERM 49	BEND TERMINATOR	R- 23	1.8	28.5	28.5	1.5	1.51	.99					
147.2	TERM 50	BEND TERMINATOR	B- 30	.2	25.4	25.4	1.5	1.05	.62	.20	500.0	500.0	80.0	800.0
147.0	TERM 51	BEND TERMINATOR	B- 31	.7	22.2	22.2	1.5	1.10	.66	.20	2000.0	552.0	80.0	800.0
146.3	TERM 52	BEND TERMINATOR	B- 32	2.1	26.0	26.0	1.5	1.04	.61	.20	600.0	450.0	80.0	800.0
144.2	TERM 53	BEND TERMINATOR	R- 24	2.9	31.2	31.2	1.5	1.51	.99					
141.3	TERM 54	BEND TERMINATOR	B- 33	1.3	31.1	31.1	1.5	1.05	.62	.20	1000.0	450.0	80.0	800.0
140.0	TERM 55	BEND TERMINATOR	B- 34	.5	31.0	31.0	1.5	1.10	.66	.20	1900.0	522.0	80.0	800.0
139.5	TERM 56	BEND TERMINATOR	R- 25	1.3	34.5	34.5	1.5	1.51	.99					
138.2	TERM 57	BEND TERMINATOR	B- 35	.4	38.4	38.4	1.5	.35	.27	.20	1100.0	565.0	80.0	800.0
137.8	TERM 58	BEND TERMINATOR	R- 26	1.4	38.0	38.0	1.5	1.51	.99					
136.4	TERM 59	BEND TERMINATOR	B- 36	.4	37.0	37.0	1.5	1.08	.64	.20	1500.0	500.0	80.0	800.0
136.0	TERM 60	BEND TERMINATOR	B- 37	1.5	36.0	36.0	1.5	1.05	.62	.20	900.0	350.0	80.0	800.0
134.5	TERM 61	BEND TERMINATOR	B- 38	1.1	35.0	35.0	1.5	1.16	.71	.20	3000.0	400.0	80.0	800.0
133.4	TERM 62	BEND TERMINATOR	R- 27	3.2	34.8	34.8	1.5	1.51	.99					
130.2	TERM 63	BEND TERMINATOR	B- 39	.6	34.1	34.1	1.5	.70	.50	.20	2600.0	482.0	80.0	800.0
129.6	TERM 64	BEND TERMINATOR	R- 28	13.0	40.0	40.0	1.5	1.51	.99					
116.6	LOCK 2	COFFEEVILLE L&D	R- 29	1.0	20.0	20.0	1.5	1.51	.99					
115.6	TERM 65	BEND TERMINATOR	B- 40	.7	20.8	20.8	1.5	1.16	.71	.20	3000.0	300.0	80.0	800.0
114.9	TERM 66	BEND TERMINATOR	R- 30	6.9	17.1	17.1	1.5	1.51	.99					
108.0	TERM 67	BEND TERMINATOR	B- 41	1.7	12.9	12.9	1.5	1.05	.62	.20	1000.0	239.0	80.0	600.0
106.3	TERM 68	BEND TERMINATOR	R- 31	2.0	17.0	17.0	1.5	1.51	.99					
104.3	TERM 69	BEND TERMINATOR	B- 42	1.3	18.0	18.0	1.5	1.09	.65	.20	1700.0	550.0	80.0	800.0
103.0	TERM 70	BEND TERMINATOR	R- 32	4.3	19.0	19.0	1.5	1.27	.86					
98.7	TERM 71	BEND TERMINATOR	B- 43	.9	19.1	19.1	1.5	.92	.64	.20	3500.0	348.0	80.0	800.0
97.8	TERM 72	BEND TERMINATOR	R- 33	2.1	25.5	25.5	1.5	1.51	.99					
95.7	TERM 73	BEND TERMINATOR	B- 44	.9	23.0	23.0	1.5	.68	.48	.20	2500.0	400.0	80.0	800.0
94.8	TERM 74	BEND TERMINATOR	R- 34	1.4	21.8	21.8	1.5	1.51	.99					
93.4	TERM 75	BEND TERMINATOR	B- 45	1.3	20.5	20.5	1.5	1.18	.73	.20	3500.0	300.0	80.0	600.0
92.1	TERM 76	BEND TERMINATOR	R- 35	1.8	19.3	19.3	1.5	1.51	.99					
90.3	TERM 77	BEND TERMINATOR	B- 46	.9	18.0	18.0	1.5	.49	.36	.20	1700.0	300.0	80.0	800.0
83.4	TERM 78	BEND TERMINATOR	R- 36	.7	16.8	16.8	1.5	1.51	.99					
88.7	TERM 79	BEND TERMINATOR	B- 47	1.2	15.5	15.5	1.5	.99	.68	.20	3800.0	400.0	80.0	800.0
87.5	TERM 80	BEND TERMINATOR	B- 48	1.5	14.3	14.3	1.5	1.16	.71	.20	3000.0	400.0	80.0	800.0
86.0	TERM 81	BEND TERMINATOR	B- 49	1.7	13.0	13.0	1.5	1.09	.66	.20	1000.0	200.0	80.0	800.0
84.3	TERM 82	BEND TERMINATOR	B- 50	.9	11.7	11.7	1.5	1.13	.68	.20	2500.0	373.0	80.0	800.0
83.4	TERM 83	BEND TERMINATOR	B- 51	1.4	14.1	14.1	1.5	1.10	.66	.20	2000.0	333.0	80.0	800.0
82.0	TERM 84	BEND TERMINATOR	B- 52	2.0	14.0	14.0	1.5	1.07	.64	.20	1400.0	350.0	80.0	800.0
80.0	TERM 85	BEND TERMINATOR	B- 53	1.0	15.0	15.0	1.5	1.16	.71	.20	3000.0	450.0	80.0	800.0
79.0	TERM 86	BEND TERMINATOR	R- 37	2.0	15.5	15.5	1.5	1.51	.99					
77.0	TERM 87	BEND TERMINATOR	B- 54	1.0	15.6	15.6	1.5	1.21	.75	.20	4000.0	351.0	80.0	800.0
76.0	TERM 88	BEND TERMINATOR	R- 38	.5	13.5	13.5	1.5	1.51	.99					
75.5	TERM 89	BEND TERMINATOR	B- 55	1.6	11.4	11.4	1.5	1.16	.71	.20	3000.0	347.0	80.0	800.0

TABLE 12 (Contd)

WATERWAY NETWORK - RIVER POINTS, REACHES, AND BENDS

	RIVER POINTS		REACH OR BEND	LENGTH (MI)	DEPTH (FT) AVG	DEPTH (FT) MIN	CURRENT (MPH)	COEFFICIENTS UP	COEFFICIENTS DN	COEFFICIENTS FL	BEND RADIUS (FT)	BEND WIDTH (FT)	CLEARANCE WIDTH (FT)	FLANKING LENGTH (FT)
73.9	TERM 90	BEND TERMINATOR	B- 56	1.4	14.3	14.3	1.5	.56	.41	.20	2000.0	295.0	80.0	800.0
72.5	TERM 91	BEND TERMINATOR	B- 57	.8	16.7	16.7	1.5	1.10	.66	.20	2000.0	422.0	80.0	800.0
71.7	TERM 92	BEND TERMINATOR	B- 58	1.6	19.3	19.3	1.5	.56	.41	.20	2000.0	350.0	80.0	800.0
70.1	TERM 93	BEND TERMINATOR	B- 59	1.6	13.7	13.7	1.5	.70	.50	.20	2600.0	304.0	80.0	800.0
68.5	TERM 94	BEND TERMINATOR	R- 39	1.0	14.5	14.5	1.5	1.51	.99					
67.5	TERM 95	BEND TERMINATOR	B- 60	1.3	15.3	15.3	1.5	1.12	.68	.20	2300.0	290.0	80.0	800.0
66.2	TERM 96	BEND TERMINATOR	R- 40	2.1	16.0	16.0	1.5	1.51	.99					
64.1	TERM 97	BEND TERMINATOR	B- 61	.5	16.5	16.5	1.5	1.10	.66	.20	2000.0	400.0	80.0	800.0
63.6	TERM 98	BEND TERMINATOR	B- 62	1.4	17.0	17.0	1.4	1.09	.65	.20	1700.0	500.0	80.0	800.0
62.2	TERM 99	BEND TERMINATOR	R- 41	1.7	17.0	17.0	1.5	1.51	.99					
60.5	TERM100	BEND TERMINATOR	B- 63	.9	17.6	17.6	1.5	1.08	.64	.20	1500.0	401.0	80.0	800.0
59.6	TERM101	BEND TERMINATOR	R- 42	3.6	22.0	22.0	1.5	1.51	.99					
56.0	TERM102	BEND TERMINATOR	B- 64	.7	27.9	27.9	1.5	1.06	.63	.20	1100.0	471.0	80.0	800.0
55.3	TERM103	BEND TERMINATOR	R- 43	4.3	27.5	27.5	1.5	1.51	.99					
51.0	TERM104	BEND TERMINATOR	B- 65	.8	27.0	27.0	1.5	1.10	.66	.20	1900.0	500.0	80.0	800.0
50.2	TERM105	BEND TERMINATOR	R- 44	1.2	26.5	26.5	1.5	1.51	.99					
49.0	TERM106	BEND TERMINATOR	B- 66	.5	26.4	26.4	1.5	.49	.36	.20	1700.0	611.0	80.0	800.0
48.5	TERM107	BEND TERMINATOR	R- 45	3.5	26.5	26.5	1.5	1.51	.99					
45.0	PORT 3	ALABAMA R FLEETING												

SECTOR 30 MOBILE RIVER

	RIVER POINTS		REACH OR BEND	LENGTH (MI)	DEPTH (FT) AVG	DEPTH (FT) MIN	CURRENT (MPH)	COEFFICIENTS UP	COEFFICIENTS DN	COEFFICIENTS FL	BEND RADIUS (FT)	BEND WIDTH (FT)	CLEARANCE WIDTH (FT)	FLANKING LENGTH (FT)
45.0	PORT 1	ALABAMA R FLEETING	R- 1	5.7	27.0	27.0	1.5	1.51	.99					
39.3	TERM 1	BEND TERMINATOR	B- 1	1.1	28.6	28.6	1.5	.35	.27	.20	1100.0	459.0	80.0	800.0
38.2	TERM 2	BEND TERMINATOR	R- 2	1.3	28.0	28.0	1.5	1.51	.99					
36.9	TERM 3	BEND TERMINATOR	B- 2	.4	26.9	26.9	1.5	1.08	.64	.20	1500.0	440.0	80.0	800.0
36.5	TERM 4	BEND TERMINATOR	R- 3	1.2	27.5	27.5	1.5	1.51	.99					
35.3	TERM 5	BEND TERMINATOR	B- 3	2.3	28.0	28.0	1.5	1.10	.66	.20	1900.0	400.0	80.0	800.0
33.0	TERM 6	BEND TERMINATOR	R- 4	.7	28.5	28.5	1.5	1.51	.99					
32.3	TERM 7	BEND TERMINATOR	B- 4	.6	28.5	28.5	1.5	1.08	.64	.20	1500.0	400.0	80.0	800.0
31.7	TERM 8	BEND TERMINATOR	R- 5	1.2	29.0	29.0	1.5	1.51	.99					
30.5	PORT 2	MOBILE RIVER	R- 6	2.5	29.0	29.0	1.5	1.51	.93					
28.0	TERM 9	BEND TERMINATOR	B- 5	2.0	28.2	28.2	1.5	1.05	.62	.20	900.0	466.0	80.0	800.0
26.0	TERM 10	BEND TERMINATOR	R- 7	2.0	31.0	31.0	1.5	1.51	.99					
24.0	TERM 11	BEND TERMINATOR	B- 6	2.3	33.2	33.2	1.5	1.05	.62	.20	1000.0	507.0	80.0	800.0
21.7	TERM 12	BEND TERMINATOR	R- 8	8.1	34.0	34.0	1.5	1.51	.93					
13.6	TERM 13	BEND TERMINATOR	B- 7	2.0	35.0	35.0	1.5	1.03	.71	.20	4000.0	146.0	80.0	800.0
11.6	TERM 14	BEND TERMINATOR	R- 9	11.6	36.0	36.0	1.5	1.51	.93					
0.	PORT 3	APE MOBILE AREA												

RIVER SYSTEM 18 BLACK WARRIOR RIVER (16)

SECTOR 27 BLACK WARRIOR RIVER

	RIVER POINTS		REACH OR BEND	LENGTH (MI)	DEPTH (FT) AVG	DEPTH (FT) MIN	CURRENT (MPH)	COEFFICIENTS UP	COEFFICIENTS DN	COEFFICIENTS FL	BEND RADIUS (FT)	BEND WIDTH (FT)	CLEARANCE WIDTH (FT)	FLANKING LENGTH (FT)
0.	PORT 1	BANKHEAD POOL	R- 1	30.7	10.5	10.5	1.5	.92	.92					

TABLE 12 (Contd)

WATERWAY NETWORK - RIVER POINTS, REACHES, AND BENDS

RIVER POINTS				REACH OR BEND	LENGTH (MI)	DEPTH (FT) AVG	DEPTH (FT) MIN	CURRENT (MPH)	COEFFICIENTS UP	COEFFICIENTS DN	COEFFICIENTS FL	BEND RADIUS (FT)	BEND WIDTH (FT)	CLEARANCE WIDTH (FT)	FLANKING LENGTH (FT)
30.7	LOCK	1	BANKHEAD L&D	R- 2	9.1	10.5	10.5	1.5	.92	.92					
39.8	PORT	2	HOLT POOL	R- 3	9.4	10.5	10.5	1.5	.92	.92					
43.2	LOCK	2	HOLT L&D	R- 4	1.2	10.5	10.5	1.5	.92	.92					
50.4	PORT	3	OLIVER POOL	R- 5	7.7	10.5	10.5	1.5	.92	.92					
58.1	LOCK	3	OLIVER L&D	R- 6	1.1	10.5	10.5	1.5	.92	.92					
59.2	PORT	4	WARRIOR POOL	R- 7	75.9	10.5	10.5	1.5	.92	.92					
135.1	LOCK	4	WARRIOR L&D	R- 8	44.1	10.5	10.5	1.5	.92	.92					
179.2	PORT	5	TTW/BLCK WARR FLEET												

RIVER SYSTEM 19 TENN-TOM WATERWAY (19)

SECTOR 26 TENNESSEE-TOMBIGBEE

0.	PORT	1	APE TENN R/TTW FLTG	R- 1	39.3	12.0	12.0	0.	1.00	1.00	
39.3	LOCK	1	BAY SPRINGS LOCK	R- 2	5.2	12.0	12.0	0.	1.00	1.00	
44.5	LOCK	2	LOCK E (TENN-TOM)	R- 3	8.3	12.0	12.0	0.	1.00	1.00	
52.8	LOCK	3	LOCK D (TENN-TOM)	R- 4	7.4	12.0	12.0	0.	1.00	1.00	
60.2	LOCK	4	LOCK C (TENN-TOM)	R- 5	14.7	12.0	12.0	0.	1.00	1.00	
74.9	LOCK	5	LOCK B (TENN-TOM)	R- 6	5.2	12.0	12.0	0.	1.00	1.00	
80.1	LOCK	6	LOCK A (TENN-TOM)	R- 7	6.8	10.0	10.0	1.0	1.00	1.00	
86.9	PORT	2	ABERDEEN TTW CUT	R- 8	6.8	10.0	10.0	1.0	1.00	1.00	
93.7	LOCK	7	ABERDEEN L&D	R- 9	0.	10.0	10.0	1.0	1.00	1.00	
93.7	PORT	3	COLUMBUS POOL	R- 10	22.6	10.0	10.0	1.0	1.00	1.00	
116.3	LOCK	8	COLUMBUS L&D	R- 11	0.	10.0	10.0	1.0	1.00	1.00	
116.3	PORT	4	ALICEVILLE POOL	R- 12	27.9	10.0	10.0	1.0	1.00	1.00	
144.2	LOCK	9	ALICEVILLE L&D	R- 13	0.	10.0	10.0	1.0	1.00	1.00	
144.2	PORT	5	GAINSVILLE POOL	R- 14	39.9	10.0	10.0	1.0	1.00	1.00	
184.1	LOCK	10	GAINESVILLE L&D	R- 15	48.1	10.0	10.0	1.0	1.00	1.00	
232.2	PORT	6	TTW/BLCK WARR FLEET								

RIVER SYSTEM 20 GREEN-BARREN RIVERS (20)

SECTOR 8 GREEN & BARREN RIVER

0.	PORT	1	APE GREEN POOLS 2-3	R- 1	46.7	20.0	11.0	.5	.65	.65	
46.7	PORT	2	1005 GREEN POOL 1	R- 2	40.6	20.0	11.0	.5	.65	.65	
87.3	PORT	3	GREEN RIVER FLEETNG								

D-12

TABLE 13

ROUTING TABLE

FROM SECTOR	TO SECTOR 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1		D- 2-D	D- 2-D	D- 2-D	D- 2-D	D- 2-D	D- 2-D	D- 2-D	D- 2-D	D- 2-D	D- 2-D	D- 2-D	D- 2-D	D- 2-D	D- 2-D
2	U- 1-U		D- 3-D	D- 3-D	D- 3-D	D- 3-D	D- 3-D	D- 3-D	D- 3-D	D- 3-D	D- 3-D	D- 3-D	D- 3-D	D- 3-D	D- 3-D
3	U- 2-U	U- 2-U		D- 4-U	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D
4	D- 3-U	D- 3-U	D- 3-U		D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D
5	U- 3-U	U- 3-U	U- 3-U	U- 4-U		D- 6-U	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D
6	D- 5-U	D- 5-U	D- 5-U	D- 5-U	D- 5-U		D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D
7	U- 5-U	U- 5-U	U- 5-U	U- 5-U	U- 5-U	U- 6-U		D- 8-U	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D
8	D- 7-U	D- 7-U	D- 7-U	D- 7-U	D- 7-U	D- 7-U	D- 7-U		D- 9-D	D- 9-D	D- 3-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D
9	U- 7-U	U- 7-U	U- 7-U	U- 7-U	U- 7-U	U- 7-U	U- 7-U	U- 8-U		D-14-U	D-14-U	D-14-U	D-14-U	D-14-U	D-15-D
10	D-14-D	D-14-D	D-14-D	D-14-D	D-14-D	D-14-D	D-14-D	D-14-D	D-14-D		D-13-U	D-13-U	D-13-U	D-14-D	D-14-D
11	D-12-D	D-12-D	D-12-D	D-12-D	D-12-D	D-12-D	D-12-D	D-12-D	D-12-D	D-12-D		D-12-D	D-12-D	D-12-D	D-12-D
12	D-13-D	D-13-D	D-13-D	D-13-D	D-13-D	D-13-D	D-13-D	D-13-D	D-13-D	D-13-D	U-11-U		D-13-D	D-13-D	D-13-D
13	D-14-D	D-14-D	D-14-D	D-14-D	D-14-D	D-14-D	D-14-D	D-14-D	D-14-D	D-10-U	U-12-U	U-12-U		D-14-D	D-14-D
14	D- 9-U	D- 9-U	D- 9-U	D- 9-U	D- 9-U	D- 9-U	D- 9-U	D- 9-U	D- 9-U	U-10-U	U-13-U	U-13-U	U-13-U		D-15-D
15	U- 9-U	U- 9-U	U- 9-U	U- 9-U	U- 9-U	U- 9-U	U- 9-U	U- 9-U	U- 9-U	U-14-U	U-14-U	U-14-U	U-14-U	U-14-U	
16	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D
17	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D
18	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-U	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D
19	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D
20	D-15-U	D-15-U	D-15-U	D-15-U	D-15-U	D-15-U	D-15-U	D-15-U	D-15-U	D-15-U	D-15-U	D-15-U	D-15-U	D-15-U	D-15-U
21	U-15-U	U-15-U	U-15-U	U-15-U	U-15-U	U-15-U	U-15-U	U-15-U	U-15-U	U-15-U	U-15-U	U-15-U	U-15-U	U-15-U	U-15-U
22	D-21-U	D-21-U	D-21-U	D-21-U	D-21-U	D-21-U	D-21-U	D-21-U	D-21-U	D-21-U	D-21-U	D-21-U	D-21-U	D-21-U	D-21-U
23	U-21-U	U-21-U	U-21-U	U-21-U	U-21-U	U-21-U	U-21-U	U-21-U	U-21-U	U-21-U	U-21-U	U-21-U	U-21-U	U-21-U	U-21-U
24	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U
25	D-30-U	D-30-U	D-30-U	D-30-U	D-30-U	D-30-U	D-30-U	D-30-U	D-30-U	D-30-U	D-30-U	D-30-U	D-30-U	D-30-U	D-30-U
26	U-13-D	U-13-D	U-13-D	U-13-D	U-13-D	U-13-D	U-13-D	U-13-D	U-13-D	U-13-D	U-12-U	U-12-U	U-13-D	U-13-D	U-13-D
27	D-26-U	D-26-U	D-26-U	D-26-U	D-26-U	D-26-U	D-26-U	D-26-U	D-26-U	D-26-U	D-26-U	D-26-U	D-26-U	D-26-U	D-26-U
28	U-26-U	U-26-U	U-26-U	U-26-U	U-26-U	U-26-U	U-26-U	U-26-U	U-26-U	U-26-U	U-26-U	U-26-U	U-26-U	U-26-U	U-26-U
29	D-28-U	D-28-U	D-28-U	D-28-U	D-28-U	D-28-U	D-28-U	D-28-U	D-28-U	D-28-U	D-28-U	D-28-U	D-28-U	D-28-U	D-28-U
30	U-28-U	U-28-U	U-28-U	U-28-U	U-28-U	U-28-U	U-28-U	U-28-U	U-28-U	U-28-U	U-28-U	U-28-U	U-28-U	U-28-U	U-28-U
31	U-30-U	U-30-U	U-30-U	U-30-U	U-30-U	U-30-U	U-30-U	U-30-U	U-30-U	U-30-U	U-30-U	U-30-U	U-30-U	U-30-U	-30-U
32	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	23-U
33	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D
34	D-31-U	D-31-U	D-31-U	D-31-U	D-31-U	D-31-U	D-31-U	D-31-U	D-31-U	D-31-U	D-31-U	D-31-U	D-31-U	D-31-U	D-32-D

TABLE 13 (Contd)

ROUTING TABLE

FROM SECTOR	TO SECTOR 16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	D- 2-D	D- 2-D	D- 2-D	D- 2-D	D- 2-D	D- 2-D	D- 2-D	D- 2-D	D- 2-D	D- 2-D	D- 2-D	D- 2-D	D- 2-D	D- 2-D	D- 2-D
2	D- 3-D	D- 3-D	D- 3-D	D- 3-D	D- 3-D	D- 3-D	D- 3-D	D- 3-D	D- 3-D	D- 3-D	D- 3-D	D- 3-D	D- 3-D	D- 3-D	D- 3-D
3	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D
4	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D	D- 5-D
5	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D
6	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D	D- 7-D
7	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D
8	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D	D- 9-D
9	D-15-D	D-15-D	D-15-D	D-15-D	D-15-D	D-15-D	D-15-D	D-15-D	D-15-D	D-14-U	D-14-U	D-14-U	D-14-U	D-14-U	D-14-U
10	D-14-D	D-14-D	D-14-D	D-14-D	D-14-D	D-14-D	D-14-D	D-14-D	D-14-D	D-13-U	D-13-U	D-13-U	D-13-U	D-13-U	D-13-U
11	D-12-D	D-12-D	D-12-D	D-12-D	D-12-D	D-12-D	D-12-D	D-12-D	D-12-D	D-12-D	D-12-D	D-12-D	D-12-D	D-12-D	D-12-D
12	D-13-D	D-13-D	D-13-D	D-13-D	D-13-D	D-13-D	D-13-D	D-13-D	D-13-D	D-26-D	D-26-D	D-26-D	D-26-D	D-26-D	D-26-D
13	D-14-D	D-14-D	D-14-D	D-14-D	D-14-D	D-14-D	D-14-D	D-14-D	D-14-D	U-26-D	U-26-D	U-26-D	U-26-D	U-26-D	U-26-D
14	D-15-D	D-15-D	D-15-D	D-15-D	D-15-D	D-15-D	D-15-D	D-15-D	D-15-D	U-13-U	U-13-U	U-13-U	U-13-U	U-13-U	U-13-U
15	D-20-U	D-20-U	D-20-U	D-20-U	D-20-U	D-21-D	D-21-D	D-21-D	D-21-D	U-14-U	U-14-U	U-14-U	U-14-U	U-14-U	U-14-U
16		D-17-U	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D
17	D-16-U		D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D	D-18-D
18	U-16-U	U-17-U		D-19-U	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D
19	D-18-U	D-18-U	D-18-U		D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D	D-20-D
20	U-18-U	U-18-U	U-18-U	U-19-U		D-21-D	D-21-D	D-21-D	D-21-D	D-15-U	D-15-U	D-15-U	D-15-U	D-15-U	D-15-U
21	U-20-U	U-20-U	U-20-U	U-20-U	U-20-U		D-22-U	D-23-D	D-23-D	D-23-D	U-15-U	D-23-D	D-23-D	D-23-D	D-23-D
22	D-21-U	D-21-U	D-21-U	D-21-U	D-21-U	D-21-U		D-23-D	D-23-D	D-23-D	D-21-U	D-23-D	D-23-D	D-23-D	D-23-D
23	U-21-U	U-21-U	U-21-U	U-21-U	U-21-U	U-21-U	U-22-U		D-24-U	D-32-U	D-32-U	D-32-U	D-32-U	D-32-U	D-32-U
24	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U		D-32-U	D-32-U	D-32-U	D-32-U	D-32-U	D-32-U
25	D-30-U	D-30-U	D-30-U	D-30-U	D-30-U	D-31-D	D-31-D	D-31-D	D-31-D		D-30-U	D-30-U	D-30-U	D-30-U	D-30-U
26	U-13-D	U-13-D	U-13-D	U-13-D	U-13-D	U-13-D	U-13-D	D-28-D	D-28-D	D-28-D		D-27-U	D-28-D	D-28-D	D-28-D
27	D-26-U	D-26-U	D-26-U	D-26-U	D-26-U	D-28-D	D-28-D	D-28-D	D-28-D	D-28-D	D-26-U		D-28-D	D-28-D	D-28-D
28	U-26-U	U-26-U	U-26-U	U-26-U	U-26-U	D-30-D	D-30-D	D-30-D	D-30-D	D-30-D	U-26-U	U-27-U		D-30-D	D-30-D
29	D-28-U	D-28-U	D-28-U	D-28-U	U-28-U	D-30-D	D-30-D	D-30-D	D-30-D	D-30-D	D-28-U	D-28-U	D-28-U		D-30-D
30	U-28-U	U-28-U	U-28-U	U-28-U	U-28-U	D-31-D	D-31-D	D-31-D	D-31-D	D-25-U	U-28-U	U-28-U	U-28-U	U-29-U	
31	U-30-U	U-30-U	U-30-U	U-30-U	U-30-U	D-32-D	D-32-D	D-32-D	D-32-D	U-25-U	U-30-U	U-30-U	U-30-U	U-30-U	U-30-U
32	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-23-U	D-24-U	U-31-U	U-31-U	U-31-U	U-31-U	U-31-U	U-31-U
33	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-31-U	D-31-U	D-31-U	D-31-U	D-31-U	D-31-U
34	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D	D-32-D

TABLE 13 (Contd)

ROUTING TABLE

TO SECTOR

FROM SECTOR	31	32	33	34
1	D- 2-D	D- 2-D	D- 2-D	D- 2-D
2	D- 3-D	D- 3-D	D- 3-D	D- 3-D
3	D- 5-D	D- 5-D	D- 5-D	D- 5-D
4	D- 5-D	D- 5-D	D- 5-D	D- 5-D
5	D- 7-D	D- 7-D	D- 7-D	D- 7-D
6	D- 7-D	D- 7-D	D- 7-D	D- 7-D
7	D- 9-D	D- 9-D	D- 9-D	D- 9-D
8	D- 9-D	D- 9-D	D- 9-D	D- 9-D
9	D-14-U	D-14-U	D-15-D	D-14-U
10	D-13-U	D-13-U	D-14-D	D-13-U
11	D-12-D	D-12-D	D-12-D	D-12-D
12	D-26-D	D-26-D	D-13-D	D-26-D
13	U-26-D	U-26-D	D-14-D	U-26-D
14	U-13-U	U-13-U	D-15-D	U-13-U
15	U-14-U	U-14-U	D-21-D	U-14-U
16	D-18-D	D-18-D	D-18-D	D-18-D
17	D-18-D	D-18-D	D-18-D	D-18-D
18	D-20-D	D-20-D	D-20-D	D-20-D
19	D-20-D	D-20-D	D-20-D	D-20-D
20	D-15-U	D-15-U	D-21-D	D-15-U
21	D-23-D	D-23-D	D-23-D	D-23-D
22	D-23-D	D-23-D	D-23-D	D-23-D
23	D-32-U	D-32-U	D-32-U	D-32-U
24	D-32-U	D-32-U	D-32-U	D-32-U
25	D-31-D	D-31-D	D-31-D	D-31-D
26	D-28-D	D-28-D	D-28-D	D-28-D
27	D-28-D	D-28-D	D-28-D	D-28-D
28	D-30-D	D-30-D	D-30-D	D-30-D
29	D-30-D	D-30-D	D-30-D	D-30-D
30	D-31-D	D-31-D	D-31-D	D-31-D
31		D-32-D	D-33-U	D-34-U
32	U-31-U		U-33-U	U-34-U
33	D-31-U	D-32-D		D-34-U
34	D-31-U	D-32-D	D-33-U	

APPENDIX C

ENVIRONMENTAL

SECTION I CULTURAL RESOURCES OVERVIEW AND MANAGEMENT SURVEY

SECTION II 404

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Environmental

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PHASE I ARCHAEOLOGICAL RECONNAISSANCE OF THE OLIVER LOCK AND DAM PROJECT AREA TUSCALOOSA COUNTY, ALABAMA

by

Lawrence S. Alexander

With a Contribution by

Vernon J. Knight, Jr.

Office of Archaeological Research
The University of Alabama
Report of Investigations 33

Prepared under the Supervision of

Carey B. Oakley
Principal Investigator

Submitted to:

United States Army Corps of Engineers
Mobile District
P.O. Box 2288
Mobile, Alabama

Contract Number DACW01-82-C-0028

September 16, 1982

CHAPTER I

OVERVIEW AND MANAGEMENT SUMMARY

INTRODUCTION

At the request of the Mobile District Corps of Engineers a documentary and literature search and a cultural resources reconnaissance of 1100 acres (442.9 ha) (Figure 1) within the boundaries of the proposed relocation of the William Bacon Oliver Lock and Dam, Tuscaloosa, was conducted by The University of Alabama, Office of Archaeological Research (OAR) between February 1 and March 5, 1982. Cultural resources located within the project area ranged from Middle Archaic campsites to a middle twentieth century tenant farm house. The cultural resources survey located 49 sites within the project area. Ten sites were recommended for further evaluation. The site inventory is listed in Table 1.

This summary includes a review of the literature search, field investigation procedures, site evaluation criteria, and an inventory of the sites located within the project area. The site summary section includes recommendations for further resource management of the located sites.

PROJECT AREA

The Oliver Lock and Dam project area is located in central Tuscaloosa County on the western edge of Tuscaloosa, Alabama (Figure 1). The project area covers 1100 acres (442.9 ha) which is divided into a northern and southern portion by the Black Warrior River. The northern portion consists of 989 acres (400.4 ha) and the southern portion consists of 105 acres (42.5 ha).

The project area is immediately downstream from the Fall Line at Tuscaloosa. Above the Fall Line, the river is entrenched in Paleozoic sandstones and shales. Below the Fall Line the river meanders through unconsolidated Cretaceous deposits of sand, clay, and gravel. This geological break represents a significant transition in ecology and in the sedimentation pattern of the Black Warrior River.

INVESTIGATION PROCEDURES

Documentary and Literature Review

A documentary and literature review for the project area and surrounding region was conducted by Vernon J. Knight, Jr. After a brief preliminary document search during the initial phase of investigations, relevant archives, manuscripts, and published works were examined in greater detail. The findings, with appended chronologies, bibliographies, or source materials, are presented in Chapter III of this report.

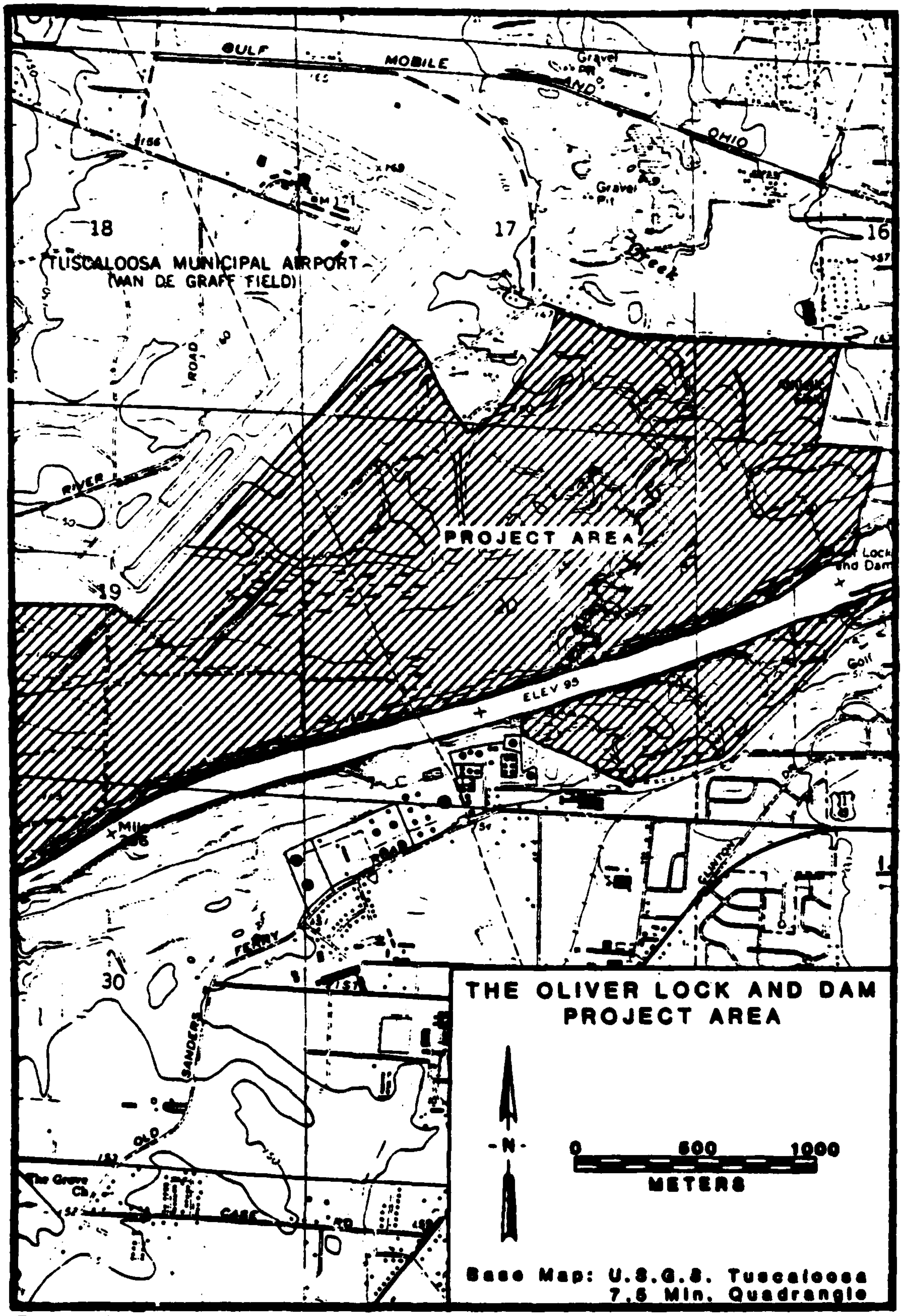
GULF
MOBILE
AND
OHIO
Gravel Pit
18
17
16
TUSCALOOSA MUNICIPAL AIRPORT
(VAN DE GRAFF FIELD)
ROAD
RIVER
PROJECT AREA
Lock and Dam
19
ELEV 95
Golf
FERRY
30
SANDERS
OLD
THE OLIVER LOCK AND DAM
PROJECT AREA
N
0
500
1000
METERS
Base Map: U.S.G.S. Tuscaloosa
7.5 Min. Quadrangle

Figure 1.

Table 1. Oliver Lock and Dam Site Inventory.

	Topographic Location	Level of Investigation	Site Type	Component Present	Intact Deposits	Potential NRHP Eligibility	Recommendations
1Tu264	T-1RCL	CM,TP,CA	6F	LW,M,H	SD	Yes	PhII;CSC,DT,ST,TP
1Tu265	T-1RCL	SC,CM,TE	6B	GF,LW	SPF	Yes	PhII;CSC,DT,ST,TP
1Tu266	T-1RCL	SC,TE	5F	LA,GF, LW,M,H	SPF	Yes	PhII;CSC,DT,ST,TP
1Tu308	T-2	SC	3D	MA,LA,GF, MW,LW,M,H	DEC	No	N
1Tu421	T-1RCL	SC,TE	5E	MA,GF,LW,M	SPF,SD	Yes	PhII;CSC,DT,TP
1Tu422	T-1RCL	SC	3D	M	DEC	No	N
1Tu423	T-1RCL	SC,TE	4D	LA,GF,LW, M,H	SD	Yes	PhII;CSC,DT,ST,TP
1Tu426	T-1RCL	SC,CM,TP	5C	MW,LW,M,H	SPF	Yes	PhII;CSC,DT,ST,TP
1Tu427	T-1RCL	SC,TE	6F	LW,M	UP,SPF	Yes	PhII;CSC,DT,TP
1Tu428	T-1M	SC,TE	1F	MA,LA,GF, MW,LW,H	Undet.	Undet.	N
1Tu429	T-1M	SC	4C	LW,H	DEC	No	N
1Tu430	T-1L	SC,TE	2C	LW,M	Undet.	No	N
1Tu431	T-1L	SC	2F	LA,LW,M,H	Undet.	No	N
1Tu432	T-1L	SC,TE	4D	LW,M,H	SD	Yes	N
1Tu433	T-1L	SC,TE	2D	LA,GF,LW M,H	Undet.	No	N
1Tu434	T-1L	SC,TE	3C	LW,M,H	SD	No	N
1Tu435	T-1M	SC	3C	X	DEC	No	N
1Tu436	T-1M	SC,TE	5E	LA,GF,MW, LW,M,H	SPF	Yes	PhII;CSC,DT,ST
1Tu437	T-1M	SC	1D	X,H	DEC	No	N
1Tu438	T-2	SC,TE	4C	EA,MW,LW,H	SPF	No	N
1Tu439	T-2	SC	2C	X,H	DEC	No	N
1Tu440	T-2	SC	3B	X,H	DEC	No	N
1Tu441	T-2	SC,M,PH,HD	5B	X,H	Undet.	Undet.	PhII;ST,TP
1Tu442	T-2	SC	2C	MA,LA,LW	DEC	No	N
1Tu443	AF-1	SC	2C	EA	DEC	No	N
1Tu444	T-2	CM,TE	4F	X	UP	Yes	PhII;TP
1Tu445	AF-1	SC	2C	X	DEC	No	N
1Tu446	AF-1	SC	1C	LW	DEC	No	N
1Tu447	AF-1	SC,CM	5C	X,H	DEC	No	N
1Tu448	AF-1	SC,CM	1C	X,H	DEC	No	N
1Tu449	T-2	SC	1B	LW,H	DEC	No	N
1Tu450	AF-1a	CM,TE	3F	GF	SD	No	N
1Tu451	T-1M	SC	3E	X	DEC	No	N
1Tu452	T-2	SC	2D	X	DEC	No	N
1Tu453	T-1M	CM,TE	2B	X	DEC	No	N
1Tu454	AF-1a	CM,TE	2A	GF,LW	UP	No	N
1Tu455	T-2	SC	1B	X,H	DEC	No	N
1Tu456	T-2	PH,HD	3B	H	DEC	No	N
1Tu457	T-1RCL	SC,HD	4C	X,H	DEC	No	N
1Tu458	T-1RCL	SC	4C	LA,LW	DEC	No	N
1Tu459	T-2	SC,TE	4C	LW,M,H	DEC	No	N
1Tu460	T-1RCL	SC	2B	LW	DEC	No	N
1Tu461	T-2	SC	3C	LW	DEC	No	N
1Tu462	T-2	SC,HD	3D	MW,H	DEC	No	N
1Tu463	T-2	SC,HD	5C	LA,H	DEC	No	N
1Tu464	T-2	PH,HD	5D	H	SS	No	N
1Tu465	T-1RCL	PH,HD	—	H	SS	No	N
1Tu466	T-1RCL	PH,HD,TE	2C	H	DEC	No	N
1Tu467	T-1RCL	CM,TE	2C	LW	UP	No	N

Key:
Topographic Location: T-0 Active floodplain; T-1M Middle Holocene Terrace; T-1L Late Holocene Terrace; T-1RCL Holocene River Channel Levee; T-2 Pleistocene Terrace; AF-Alluvial Fan; C-Colluvium.
Level of Investigation: SC-Surface collection; CM-Shovel test; TE-test excavation; CA-core augering; M-mapped; PH-photographed; HD-historic documentation.
Site Type: The number refers to the artifact density. 1-Isolated finds; 2-Multiple isolated finds; 3-Minimal Artifact Concentration; 4-Moderate Artifact Concentration; 5-Dense Artifact Concentration; 6-Midden. The letter refers to the site size. A-0 to 625 square meters; B-625 to 2,500 square meters; C-2,500 to 10,000 square meters; D-10,000 to 20,000 square meters; E-20,000 to 30,000 square meters; F-30,000 to 50,000 square meters.
Components Present: E-early; M-middle; L-late; A-Archaic; GF-Gulf Formational; W-Woodland; M-Mississippian; H-Historic; X-trace or unidentified prehistoric.
Intact Deposits: DEC-Destroyed by erosion-cultivation; UP-unplowed; SPF-Subplowzone feature; SD-stratified or subplowzone deposits; SS-Standing Structure; Undet.-Undetermined.
NRHP Eligibility: Yes-Conforms to NRHP eligibility criteria; No-Does not conform to NRHP eligibility criteria; Undet.-Site Status Undetermined.
Recommendations: N-None; Undet.-Resource not evaluated; PhII-Phase II Evaluation; DT-Deep testing; CSC-Controlled Surface Collection; ST-Surface Stripping; TP-Test Pit Excavation.

Examination of the Alabama State Site Files housed at Moundville, Alabama revealed seven previously recorded archaeological sites within the project area (1Tu264, 1Tu265, 1Tu266, 1Tu308, 1Tu421, 1Tu422, 1Tu423). These sites were recorded at various times. Investigations were limited to surface collections and a preliminary determination of site components. Components dating to the Middle Archaic, Late Woodland, Mississippian, and protohistoric periods were tentatively identified at that time. In no case was there sufficient information to determine potential eligibility of these sites for the National Register of Historic Places.

The National Register of Historic Places was consulted and a representative of the Alabama Historical Commission was contacted about the possibility of National Register nominations in progress or potentially eligible properties known to that office. No National Register properties had been previously identified within the survey area.

The documentary and literature search was directed to four topics: (1) the prehistory of the lower Black Warrior region, (2) the ethnohistory of the lower Black Warrior region, (3) a particular investigation into the location and historical circumstances of Black Warrior Town, a Creek War settlement of 1813-1814, and (4) the history of settlement of the Tuscaloosa County area and the survey area in particular.

The archaeological literature of the region was reviewed and a comprehensive bibliography of published and unpublished source materials was compiled. Documentary research for the ethnohistorical overview, the historical overview, and the consideration of Black Warrior Town entailed the use of several sources. Among these were official records for Tuscaloosa County, archival repositories, and libraries in Tuscaloosa, Birmingham, and Montgomery, Alabama. Knowledgeable local informants were also interviewed.

The results of the documentary and literature review were employed to guide the assessment of the historical material remains recovered or located during the survey.

Field Reconnaissance

The field reconnaissance procedures employed within the project area were adapted to specific surface conditions encountered during the fieldwork. Generally, four types of field conditions were encountered; (1) cultivated fields, (2) areas of dense brush and timber, (3) pasture, golf course, and fallow fields, (4) areas covered by industrial trash or riprap along the river banks associated with Oliver Lock and Dam.

In cultivated fields, pedestrian transects were spaced at 20 to 25 m (65.6 to 82 ft) intervals. A representative sample of artifacts was collected and the perimeter of each site was defined. Woodlots and dense brush were shovel tested. The shovel tests were placed in transects 10 to 15 m (32.8 to 49.2 ft) apart, with special emphasis placed on testing high site probability areas. Any area not seasonally inundated throughout the project area was considered as a potential site location. These areas included pastures, fallow fields, and woodlots. Because of the limited

effectiveness of shovel testing for locating sites of low to moderate artifact density, a series of 50 by 50 cm (1.64 by 1.64 ft) test units was excavated. These units were located in areas of high probability site location where the surface could not be readily observed, and where shovel testing had located cultural deposits. Areas along the Black Warrior River where erosion exposed bank profiles were inspected for any evidence of cultural deposits. These field techniques resulted in 100 percent coverage of the project area.

Following the surface reconnaissance, the boundaries of each cultural deposit were determined and the site was surface collected. The site boundaries were determined by a consistant 10 m (32.8 ft) gap in the artifact concentrations. During the surface collection, emphasis was placed on collecting culturally diagnostic artifacts, but a sample of the entire range of artifacts present was obtained.

Testing and Evaluation

The selection of sites for further testing and evaluation was determined from the quantity and types of artifacts recovered and specific geomorphological conditions. A series of 50 by 50 cm (1.64 by 1.64 ft) test units was excavated in order to evaluate each deposit. Each test excavation was removed in 20 cm (7.9 in) levels.

The initial evaluation of a cultural resource as potentially significant and eligible for nomination to the National Register of Historic Places (NRHP) is based on the presence of undisturbed features, unplowed cultural deposits, or subplowzone cultural deposits. These sites contain undisturbed deposits and have potential to yield important information for the area history and prehistory. The sites listed in Table 1 as potentially NRHP significant possess one or more of these attributes.

There are, however, a few sites where limited testing did not locate any cultural features or undisturbed deposits. These sites exhibit evidence of special purpose activities. One is a single component farmstead. Testing of such sites represents less than a 0.01 percent sample of the site area. Further testing by removal of a sample of the plowzone of sufficient size to provide NRHP determination of eligibility is recommended.

A model of local topography and alluviation was used to develop a research design for a deep testing program to be implemented during the next stage of investigation on the Oliver Lock and Dam project area. The project area, located on the floodplain immediately down stream from the Fall Line on the Black Warrior River at Tuscaloosa, is susceptible to rapid alluviation. Deeply buried prehistoric occupational surfaces are expected. A river cutoff channel and point bar levee near the northwestern end of the project area is one location where buried cultural deposits may be present. This model of floodplain alluviation is the basis for delimiting that portion of the floodplain within the impact area which will require deep testing.

SITE SUMMARY

A total of 49 cultural resources was located and initially evaluated during this survey. Nineteen sites contained prehistoric components, twenty-six sites contained both prehistoric and historic components, and four sites contained only historic components. Two of these historic sites are standing structures, the remainder are archaeological sites. Ten of these sites have been evaluated as potentially eligible for inclusion in the NRHP. The site which contains an unplowed deposit is 1Tu444. Sites which contain subplowzone features include 1Tu265, 1Tu266, 1Tu421, 1Tu426, 1Tu427 and 1Tu436. Sites which contain stratified or subplowzone cultural deposits include 1Tu264, 1Tu421, 1Tu423, and 1Tu427.

MANAGEMENT RECOMMENDATIONS

The recommendations for the Phase II testing of ten cultural resources are based upon the NRHP evaluation of research potential for these sites. The scientific evaluation of these sites has been described in terms of the components represented, the integrity of these deposits, and the physiographic setting for each site. The sites recommended for Phase II testing include 1Tu264, 1Tu265, 1Tu266, 1Tu421, 1Tu423, 1Tu426, 1Tu427, 1Tu436, 1Tu441, and 1Tu444. These sites range from unplowed Middle and Late Archaic sites, Late Woodland-Mississippian farmsteads, to nineteenth century homesteads.

The Phase II fieldwork recommendations have been formulated with the goal of determining the NRHP significance of each site and obtaining sufficient information to facilitate the NRHP nomination, and, if necessary, recommendations for impact mitigation for these sites. Four site evaluation techniques have been suggested according to the specific situation of each site. These are a 20 percent controlled surface collection from each site, deep testing employing a backhoe under the direction of a geomorphologist, stripping of the plowzone to examine the subsoil for intact deposits, or features, and the excavation a series of 1 m test units. Each of these four techniques will be employed to evaluate the archaeological sites recommended for further testing.

APPENDIX C

SECTION II

404 EVALUATION

1. PROJECT DESCRIPTION

a. Location. The proposed plan is located in the vicinity of Tuscalcosa, Alabama, approximately 1/2-mile downstream of the existing William Bacon Oliver Lock and Dam.

b. General Description. The recommended plan consists of the construction of a new fixed crest dam 2,700 feet downstream of the existing dam, a new larger lock and lock approach channel on the right bank adjacent to the proposed dam, a run-of-the-river hydropower plant on the left bank, and a boat ramp in Mill Creek (Figure 1 of the main report). The component of this plan which is under the Section 404 requirements is the placement of the dam structure in the waters of the Black Warrior River and on its banks which are covered in places with sparsely vegetated wetlands, and the construction of a boat ramp on the banks of Mill Creek.

c. Authority and Purpose. The authority for study of this project is contained in a resolution adopted on 21 April 1950 by the Committee on Public Works of the House of Representatives which requested the Corps to determine whether any modification of the existing navigation project on the Black Warrior-Tombigbee River System is recommended. The purpose is to provide a lock of a sufficient capacity to handle river traffic.

d. General Description of Dredged or Fill Material.

(1) General Characteristics of Material. Poured concrete.

(2) Quantity of Material. 57,000 cubic yards, for the dam, 8.1 cubic yards for the boat ramp.

(3) Source of Material. Materials would be obtained locally at the direction of the contractor.

e. Description of the Proposed Discharge Site.

(1) Location. See Figure 1 of main report.

(2) Size. The dam would extend across the river a length of approximately 400 feet and would be approximately 45 feet wide at the base, covering a total of approximately .41 acres. The dam would extend through approximately .05 acres of river margin wetlands before tying into an upland area. The boat ramp would be 50 feet long and 16 feet wide. Only 27 feet will extend into the water.

(3) Type of Site. Open Water and River Margin Wetlands for the dam, and the banks of a small creek for the boat ramp.

(4) Types of Habitat. Flowing riverine system and associated river margin wetlands.

(5) Timing and Duration of Discharge. Year round during 5-year construction period.

f. Description of Disposal Method. Coffer cell construction would be used to construct the dam and the boat ramp.

II. FACTUAL DETERMINATIONS

a. Physical Substrate Determinations.

(1) Substrate Elevation and Scope. There will be no change in elevation or slope of the river bottom outside of the dam construction area. The dam will permanently cover the river bottom. The existing substrate slope at the location of the proposed boat ramp is approximately 20 percent. This slope would become approximately 15 percent upon completion of the boat ramp.

(2) Sediment Type. The dam and boat ramp would cause no change in sediment type.

(3) Dredged/Fill Material Movement. The dam and boat ramp would be stable structures and would not move.

(4) Physical Effects on Benthos. There would be a permanent loss of benthic habitat as a result of the placement of the dam. No repopulation of benthic organisms would occur on the .41 acres of existing river bottom which would be covered by the dam. There would be an insignificant effect on other aquatic species which are dependent on the benthos because of the small area affected. The concrete face of the dam would be a suitable attachment site for many types of benthic organisms. The placement of the boat ramp would have a minor effect on benthos although the surface of the ramp would provide a substrate for some benthic organisms.

(5) Actions Taken to Minimize Impacts. No actions are possible.

b. Water Circulation, Fluctuation, and Salinity Determinations.

(1) Water:

(a) Salinity. Not applicable.

(b) Water Chemistry. No change.

(c) Clarity. No change.

(d) Color. No change.

(e) Odor. No change.

(f) Taste. No change.

(g) Dissolved gas levels. No change.

(h) Nutrients. No change.

(i) Eutrophication. No change.

(2) Current patterns and circulation:

(a) Current patterns and flow. The area behind the proposed dam would increase in depth and become wider. There would be no change downstream of the proposed dam or upstream of the existing dam or in the vicinity of the boat ramp.

(b) Velocity. Water velocity would be lessened in the 2,700 feet between the existing dam and the proposed dam. There would be no change below the proposed dam, above the existing dam, or in the vicinity of the boat ramp.

(c) Stratification. No change.

(d) Hydrologic Regime. No change.

(3) Normal Water Level Fluctuations. Water level fluctuations in Oliver Pool are currently governed by releases from Holt Lock and Dam 9.5 miles upstream of the proposed dam site. There would be no charges in these fluctuations as a result of the proposed dam. There would be no change in water fluctuation as a result of the boat ramp construction.

(4) Salinity Gradients. Not applicable.

(5) Actions that will be taken to minimize impacts. No actions are possible.

c. <u>Suspended Particulate/Turbidity Determinations</u>.

(1) Suspected Changes in Suspended Particulates and Turbidity Levels on Vicinity of Disposal Site. There would be no long-term change in suspended particulate or turbidity levels due to this proposed plan. The use of coffer cells would serve to minimize short-term increases in turbidity due to construction activities.

(2) Effects on Chemical and Physical Properties of the Water Column.

(a) Light penetration. There would be a short-term decrease in light penetration due to short-term increased suspended solids and turbidity during construction activities. There would be no significant long-term impacts.

(b) Dissolved Oxygen. No effect.

(c) Toxic Metals and Organics. No effect.

(d) Pathogens. No effect.

(e) Aesthetics. No effect.

(f) Others as Parameters. None.

(3) Effects on Biota.

(a) Primary Production, Photosynthesis. There would be a minor short-term effect due to decreased light penetration as discussed in IIc(2)(a) above.

(b) Suspension/Filter Feeders. Same as above.

(c) Sight Feeders. Same as above.

(4) Actions Taken to Minimize Impacts. None.

d. Contaminant Determinations. The proposed dam and boat ramp construction would not introduce, relocate, or increase contaminants.

e. Aquatic Ecosystem and Organism Determinations.

(1) Effects on Plankton. Downstream movement of zooplankton and phytoplankton would be limited by the presence of the proposed dam. However, the associated lock and lock approach channel would provide an alternate channel of movement for plankton. This provides no change from existing conditions. The proposed boat ramp would have no effect.

(2) Effects on Benthos. Approximately .41 acres of benthic bottom habitat would be permanently lost as a result of the placement of the dam. No repopulation of benthic organisms would occur on the dam site. There would be only a minor effect on other species which are dependent on the benthos because of the small area affected. Existing dam would be removed to elevation 103. The proposed boat ramp would disrupt benthos existing in the construction area, however, only a small area is affected.

(3) Effect on Nekton. Upstream and downstream movement of nekton would be limited by the presence of the proposed dam. However, the associated lock and lock approach channel would provide an alternate channel of movement. This provides no change from existing conditions. The proposed boat ramp would have no effect.

(4) Effects on Aquatic Food Web. There will be no significant effects on the aquatic food web.

(5) Effects on Special Aquatic Sites: Wetlands. The existing wetlands consist of sparsely vegetated areas on the river banks. They currently provide insignificant values to the overall system because of their limited size and sparse vegetative covering. Approximately .05 acres of wetlands would be lost due to the placement of the dam. the proposed boat ramp would have no effect.

(6) Threatened and Endangered Species. It has been determined that the American alligator (Alligator mississippiensis) could occur in the vicinity of Tuscaloosa, Alabama. The lack of suitable habitat in the study area precludes the presence of the American alligator therefore, this species will not be affected by the proposed dam.

(7) Other Wildlife. None considered.

(8) Actions to Minimize Impacts. None possible.

III. FINDINGS OF COMPLIANCE OR NONCOMPLIANCE WITH THE RESTRICTIONS ON DISCHARGE

a. Adaptation of the Section 404(b)(1) Guidelines to This Evaluation. No significant adaptation of the guidelines were made relative to this evaluation.

b. Evaluation of Availability of Practicable Alternative to the Proposed Discharge Site Which Would Have Less Adverse Impact on the Aquatic Ecosystem. Two of the alternatives also considered in the final array used the existing dam and proposed a new lock in the middle of the river with either a fixed crest spillway or a combination gated and fixed crest spillway. Because no new dam construction is involved, there would be no actions in the proposed construction that would impact wetlands under 404 jurisdiction. Section 3.0 of the EIS describes these plans in detail. No alternatives to the boat ramp other than no action has been formulated.

c. Compliance With State Water Quality Standards. State Water Quality Standards will be met.

d. Compliance With Applicable Toxic Effluent Standard or Prohibition Under Section 307 of the Clean Water Act. Full compliance where applicable.

e. Compliance With Endangered Species Act of 1973. Full compliance.

f. Compliance With Specified Protection Measures for Marine Sanctuaries Designated by the Marine Protection Research and Sanctuaries Act of 1972. Not applicable.

g. Evaluation of Extent of Degradation of the Waters of the United States.

(1) Significant Adverse Effects on Human Health and Welfare.

(a) Municipal and Private Water Supplies. No effect.

(b) Recreation and Commercial Fisheries. No significant effect.

(c) Plankton. No significant effect.

(d) Fish. No significant effect.

(e) Shellfish. No significant effect.

(f) Wildlife. No significant effect.

(g) Special aquatic sites. None present.

(2) Significant Adverse Effects on Life Stages of Aquatic Life and Other Wildlife Dependent on Aquatic Ecosystems. No significant effect.

(3) Significant Adverse Effects on Aquatic Ecosystem Diversity, Productivity, and Stability. No significant effect.

(4) Significant Adverse Effects on Recreational, Aesthetic, and Economic Values. No significant effect.

h. Appropriate and Practicable Steps Taken to Minimize Potential Adverse Impacts of the Discharge on the Aquatic Ecosystem. No steps were taken as adverse impacts to the aquatic ecosystem were insignificant overall.

i. On the Basis of the Guidelines, the Proposed Disposal Site for the Discharge of Dredged or Fill Material is specified as complying with the requirements of these guidelines.

APPENDIX D

PERTINENT CORRESPONDENCE

SECTION I	OFFICIAL CORPS OF ENGINEERS COMMENTS OR DIRECTIVES
SECTION II	FISH & WILDLIFE SERVICE COORDINATION ACT
SECTION III	COMMENTS FROM THE GENERAL PUBLIC
SECTION IV	REPORT COORDINATION MAILING LIST
SECTION V	COMMENTS ON 1983 DRAFT INTERIM REPORT

APPENDIX D

Pertinent Correspondence

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APPENDIX D

SECTION II

Fish & Wildlife Coordination Act

United States Department of the Interior
FISH AND WILDLIFE SERVICE
P.O. Drawer 1197
Daphne, Al 36526

August 17, 1983

Colonel Patrick J. Kelly
U.S. Army Corps of Engineers
P.O. Box 2288
Mobile, Alabama 36628

Dear Colonel Kelly:

Attached is the Formal Fish and Wildlife Coordination Act (FWCA) Report for the Oliver Lock and Dam portion of the Black Warrior-Tombigbee River Study. Our report analyzes possible fish and wildlife resource impacts and identifies measures that might reduce or offset resource losses. We expect that those measures we have identified to offset resource losses will be incorporated into project plans.

Throughout development of both the Draft and Final FWCA Reports, we have coordinated closely with the Game and Fish Division of the Alabama Department of Conservation and Natural Resources and have incorporated their comments into our report. We have been informed by the Division of their concurrence with our report. As soon as we receive their letter of concurrence, we will forward a copy to you.

We appreciate the opportunity to participate in the planning process. If you have any questions, please contact Mr. Dwight Cooley of my staff at 690-2181.

Sincerely,

E. L. Roach

Larry E. Goldman
Field Supervisor

United States Department of the Interior
FISH AND WILDLIFE SERVICE
P.O. Drawer 1197
Daphne, Al 36526

August 17, 1983

Colonel Patrick J. Kelly
U.S. Army Corps of Engineers
P.O. Box 2288
Mobile, Alabama 36628

Dear Colonel Kelly:

In accordance with the letter of agreement between our agencies for Fiscal Year 1983, the Fish and Wildlife Service (FWS) has completed this Fish and Wildlife Coordination Act Report relative to the Oliver Lock and Dam portion of the Black Warrior-Tombigbee River Study. The report assesses the impacts of the proposed project upon fish and wildlife resources, identifies design modifications to minimize resource losses and outlines mitigative features aimed at offsetting unavoidable fish and wildlife resource losses. Our report has been prepared under the authority of, and is submitted in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. et seq.). In keeping with the requirements of the Coordination Act, this report should be attached to, and made an integral part of, any report forwarded to Congress for consideration.

AREA DESCRIPTION

The Black Warrior River is formed by the confluence of the Locust and Mulberry Forks west of Birmingham and flows 45 miles southwest to Tuscaloosa, then south 120 miles to its junction with the tombigbee River at Demopolis. Topography in the study area is dominated by low, gently rolling formations of the Coastal Plain. The study area lies just south of the Fall Line and elevations approximate 95-123 feet above sea level along the river and 150-160 feet above sea level in upland areas.

Oliver Lock and Dam is located near Tuscaloosa, Alabama, just downstream of the point where the Black Warrior River leaves the Cumberland Plateau formations and begins to flow through the Coastal Plain. Here the floodplain changes from a narrow, rocky valley to a broad valley with many stream meanders. The dam, located 346.3 river miles above Mobile, forms Lake Oliver with an area of 790 acres, a length of 8.8 miles and a storage volume of 12,400 acre-feet at normal pool elevation of 123. The main tributaries of the Black Warrior River in the vicinity of Tuscaloosa are Hurricane Creek and North River.

Land use within the study area is predominately urban development in association with the cities of Tuscaloosa and Northport. Forested areas in the project area are limited to hardwood areas along Mill Creek near Tuscaloosa and to riparian areas along the Black Warrior River in the vicinity of both Tuscaloosa and Northport. Open fields and mixed pine-hardwood areas are found in uplands within the project area. Future land use projections for the study area indicate that urban development will continue to encroach into forested and open land areas.

FISH AND WILDLIFE RESOURCES

Aquatic Resources

The Black Warrior River supports a diverse assemblage of freshwater fishes. Approximately 110 species of warmwater fishes are known to occur in the system (Smith-Vaniz 1968). Species diversity within the study area does not approach that of the system as a whole but many species of fish utilize the area. Some 18 species of sport and commercial fishes are known to occur in the area as well as many other forage and nongame species.

Species diversity and population levels of fishes in the study area are controlled by a number of factors. Species in the main stem of the river are limited to those adapted to a slow-moving reservoir system. Fishes typical of this area include bluegill, largemouth bass, spotted bass, white crappie, channel catfish, blue catfish, longnose gar and shortnose gar in addition to many forage species. The gizzard shad is typically abundant in a reservoir system. Species more typical of a fast-moving riverine system are generally restricted to tributary streams not directly influenced by water-level manipulation. Fishes typical of this system include bluegill, longear sunfish, green sunfish, spotted bass and many species of minnows (Cyprinidae) and darters (Percidae).

The macrobenthic fauna of the project area is poorly known. Historically, 48 species of native mussels and 15 species of snails are known from the Black Warrior system. Additionally, 12 species of crayfish have been collected. The actual occurrence of any or all of these species in the project area has not been documented. Some of these species have probably been extirpated from the system as a result of not only impoundment of the Black Warrior River but also water quality degradation resulting from municipal and industrial discharges. This is especially true for Lake Oliver and that reach of the river below Oliver Lock and Dam.

The aquatic resources of Lake Oliver and that portion of the Black Warrior River flowing through the project area are depressed due to

water quality degradation. Industrial discharge into Lake Oliver commences just downstream of Holt Lock and Dam. Between Hurricane Creek and Oliver Lock and Dam, numerous industries discharge into the Black Warrior River. Almost all of these industries provide inadequate waste treatment. Further water quality degradation occurs in the immediate vicinity of Tuscaloosa-Northport just above Oliver Lock and Dam where six industrial plants discharge inadequately treated wastes, contributing additional pollutants to the Black Warrior River before it has an opportunity to recover from upstream discharge (Walls 1982).

In recognition of water quality problems in the area, the Alabama Water Improvement Commission has established a use classification of agricultural and industrial water supply for that portion of the river from Hurricane Creek to Oliver Lock and Dam. Both upstream and downstream of this stretch, the river is classified for fish and wildlife use with the exception of that portion of the North River upstream of the City of Tuscaloosa water intake which is classified for public water supply.

In addition to water quality impacts resulting from industrial and municipal discharges, low flow conditions experienced during summer months in the river above Oliver Lock and Dam (U.S. Army 1981) contribute to depressed water quality and hence, depressed aquatic resources. These low flow conditions can concentrate pollutants being discharged into the river, resulting in not only toxic impacts of the pollutants but also depressed dissolved oxygen (DO) levels. Low DO levels are known to stress aquatic organisms and if DO levels fall consistently below 5.0 milligrams per liter for extended periods, a die-off of aquatic organisms can occur. Concurrent with water quality problems associated with low flow conditions, the amount and quality of habitat available to aquatic organisms is reduced. During low flow conditions, aquatic organisms are restricted to deeper channels where water is available. Typically, these deep channels do not have the habitat diversity of shallow nearshore areas, resulting in lesser value habitat available to aquatic organisms.

The above-mentioned factors have resulted in a depressed fishery in Lake Oliver. Fishing use figures for Lake Oliver are indicative of this. Over the past decade, fishing visitation on Lake Oliver has been 13.4 percent of that on Lake Warrior immediately downstream and 22.3 percent of Lake Holt immediately upstream. The area immediately below Oliver Lock and Dam receives the heaviest fishing pressure in the project area. From these figures it is evident that use of Lake Oliver by fishing recreationists is low.

Fishing access near Oliver Lock and Dam, particularly in the area immediately downstream of the dam, appears to be limiting recreational opportunities in the project area. As mentioned above, the area downstream of the dam receives the majority of Lake Oliver fishing

use. The closest public access below the dam is at Moundville, some 20 miles downstream. In order to reach the most intensively fished area, fishermen must either launch at Moundville and travel 20 miles upstream or launch on Lake Oliver and lock through the dam; both time-consuming. Undoubtedly this discourages use of the area. According to the Alabama SCORP (Alabana Department of Conservation and Natural Resources 1981), the demand for fishing opportunities in the West Alabama Planning District (including Tuscaloosa County) will increase drastically by the year 2000. Improved access to the Black Warrior River is needed to provide for the present and future demand for fishing opportunities.

Wildlife Resources

Wildlife habitat in the project area is limited to a riparian fringe along the Black Warrior River, an area of bottomland and upland hardwood tree species along Mill Creek below the dam and a hardwood area directly across the river from Mill Creek and west of the Tuscaloosa Golf Course. Large areas of quality wildlife habitat are located downstream immediately below the project area and upstream above Tuscaloosa and Northport. Wildlife habitat within the immediate project area is limited. Industrial, residential and urban development has encroached into the floodplain leaving only a riparian fringe of vegetation and isolated forested tracts.

Downstream of Oliver Lock and Dam, the floodplain is broad and forested tracts are extensive. In this area, the forest is dominated by bald cypress, water tupelo, overcup oak, water oak, willow oak, swamp chestnut oak, Shumard oak, water elm, American elm and sugarberry. Understory species include swamp privet, red bay, flowering dogwood and rattan vine. These species are indicative of the forest type formerly existing on project lands.

Within the project area, water oak, willow oak, cottonwood, black willow, sycamore, American elm, hackberry and ironwood are common in riparian areas. In upland areas along the river, loblolly pine, shortleaf pine, sweetgum, white oak, mockernut hickory and beech occur commonly on high slopes and bluffs. Understory vegetation is dominated by flowering dogwood, red bay, rattan vine and greenbrier.

Due to urban encroachment into the project area, wildlife use is limited. Predominant game mammal and furbearer species utilizing the area include gray squirrel, rabbit, opossum, raccoon and skunk. Beaver, fox, weasel, mink and bobcat are also found here as are whitetail deer but less frequently than those species mentioned above. Game birds utilizing the area include Canada goose, mallard, pintail, American wigeon, green-winged teal, wood duck, lesser scaup, bufflehead, common goldeneye, mourning dove, and bobwhite quail. With the exception of the bobwhite quail and mourning dove, most of these bird species are only transient.

Use of the area by hunters is limited reflecting the overall low quality of game populations and their habitat in the project area and the urban influence of Tuscaloosa and Northport. In 1970, only 1,562 hunting visitations were reported for Lake Oliver as compared to 10,501 visitations downstream on Lake Warrior and 5,855 visitations upstream on Holt Lake (Walls 1982). These figures are probably representative of recent use of the area. The majority of hunting visitations occur upstream of Tuscaloosa and Northport.

Nongame wildlife populations in the project area are dominated by small mammal and migratory bird species. Small mammals are common in the area due to their mosaic of disturbed and open areas in association with isolated forested tracts. The presence of impounded waters associated with open and forested areas attract many bird species. While resident bird populations in the area may be limited, use by transient species during fall, winter and spring is extensive. It has been documented that riparian areas along watercourses are extensively used by migrating birds and may be extremely important to a number of species, especially when large tracts of forest are lacking in the immediate area such as in this case.

ENDANGERED, THREATENED AND RARE SPECIES

Endangered and threatened species use of the project area appears to be limited. There are no known resident populations of endangered and threatened species occurring in the project area. However, the bald eagle, golden eagle, peregrine falcon, osprey and swallow-tailed kite are known to be transients in the area. According to the FWS Endangered Species Field Office in Jackson, Mississippi, (reference February 1, 1982, letter to Mr. Willis E. Ruland, Mobile District, Corps of Engineers, the American alligator will not be adversely impacted by the proposed project since there appears to be no suitable habitat in the project vicinity and the spoil disposal site associated with the project is in an upland area. If, however, the scope or location of the project is changed, further coordination will be required.

PROJECT DESCRIPTION

During the planning process for the Oliver Lock and Dam portion of the Black Warrior-Tombigbee River Study, a number of alternatives were considered. On December 3, 1981, the Mobile District Corps of Engineers furnished the FWS with five structural alternatives involving various improvements to the existing facility and replacement of the existing facility with a new downstream facility. On December 23, 1982, the Mobile District, Corps of Engineers furnished the FWS with five alternatives revised from those submitted

previously. On January 5, 1983 the Mobile District, Corps of Engineers submitted to the FWS four alternatives refined from those submitted in previous correspondence. The following four alternatives were evaluated by the Corps of Engineers and were included in our draft Coordination Act Report of February 10, 1983.

Alternative 1 - This alternative involves modifications to the existing facility. A new larger lock would be constructed on the upland side of the existing lock. The new lock would replace the old 460 foot by 95 foot lift lock with a new 600 foot by 110 foot lift lock. This would probably require the relocation of the Illinois Central Gulf Railroad Bridge to permit access to the lock from upstream. The railroad spur would be relocated to the upland side of the new lock.

Alternative 2 - This alternative involves the replacement of the existing facility with a new lock and dam approximately 2700 feet downstream of the existing facility. The new dam would have a fixed crest spillway and a 600 foot by 110 foot lift lock located toward the right bank. The fixed crest spillway would be 815 feet in length at an elevation of 122.9 feet. A stilling basin would not be provided bacause of the sound rock foundation downstream of the crest. A flip basket would be provided at minimum tailwater to reaerate low flow over the spillway. Approximately 140 acres of land in three parcels are planned for disposal areas, and 800 feet of Mill Creek would be removed during excavation of the lock approach.

Alternative 3 - This alternative involves modifications to the existing facility. The old 700 foot fixed crest dam would be replaced by a 484 foot gated spillway with a new larger 600 foot by 110 foot lock located midstream. Normal upper pool elevation would be 123.0 and minimum lower pool elevation at 95.0 feet. The 484 foot gated spillway would consist of 7-60 foot gates and 8-8 foot piers. A 60 foot stilling basin would be required for the gated spillway because of high unit discharges through the spillway.

Alternative 4 - This alternative involves modification to the existing facility. The old 700 foot fixed crest dam would be replaced with a combination fixed crest-gated spillway and a new larger 600 foot 110 foot lift lock located at midstream. The replacement dam would consist of a 408 foot fixed crest spillway and a 280 foot gated spillway separated by the new lock and control station. The 280' gated spillway would consist of 4-60 foot gates and 5-9 foot piers.

All of the above alternatives were evaluated and analyzed with and without hydropower production capabilities. The powerhouse would be located on the left bank in alternatives 1 and 4 and on the right bank in alternatives 2 and 3. In addition, a spoil disposal area large enough to contain all spoil generated would be located on the north side of the river between the existing lock and dam and Mill Creek.

The plans carried to further design and evaluation prior to plan selection were Alternative 2 (downstream lock and dam) and a combination of Alternatives 3 and 4 (midstream lock at existing dam and lock) herein referred to as the combination plan. After final analysis, Alternative 2 has been chosen as the study's selected plan. However, the combination plan is also still being considered and will continue to receive additional evaluation in further project planning. The selected plan and supporting documentation is described in the June 1983 Interim Feasibility Report (IFR) and Environmental Impact Statement for Oliver Lock replacement. Our report basically addresses the selected plan and the combination plan and the Corps treatment in the IFR of FWS concerns and recommendations as expressed in our draft report of February 10, 1983.

PROJECT IMPACTS

All of the proposed alternatives for the Oliver Lock and Dam portion of the Black Warrior-Tombigbee River Study will impact the aquatic and terrestrial resources of the area. Table 1 depicts the components of each alternative that could negatively impact fish and wildlife resources. A detailed analysis of the effects of the four alternatives on fish and wildlife resources follows the table.

TABLE 1 - PROJECT-INDUCED IMPACTS FOR EACH ALTERNATIVE

Component	Cleared Area (Acres)	Disposal Material Cubic Yards	Disposal Area (Acres)
Alternative 1			
W/O hydropower	107.5	5,614,600	174.0
With hydropower	130.4	6,224,200	194.0
Alternative 2 (Selected plan)			
W/O hydropower	81.0	4,307,300	134.0
With hydropower	90.8	4,498,000	139.0
Alternative 3			
W/O hydropower	46.8	3,142,500	98.0
With hydropower	57.3	3,142,500	98.0
Alternative 4			
W/O hydropower	51.9	1.923,600	60.0
With hydropower	60.0	2,553,200	80.0

Aquatic Resources

The selected plan involves dredging and removal of significant amounts of spoil, clearing of areas to accommodate construction, and placement of spoil material. These actions will negatively impact aquatic resources in an area where these resources are already depressed due to urban encroachment and water quality degradation. Dredge spoil generated would amount to over 4,500,000 CY; area cleared for construction would comprise 90.8 acres; and the disposal area required is approximately 139 acres. The combination plan would have similar levels of impacts, although specific figures have not been made available to us for use in this report.

Dredging operations necessary to construct a new facility would impact aquatic resources initially. These short-term impacts would result from displacement and loss of macrobenthic organisms and an increase in downstream sediment loads. As bottom sediments are dredged, existing macrobenthic populations would be destroyed. These macrobenthic organisms are an important component of the aquatic ecosystem because they serve as a food source for fishery resources. At the same time, dredging would increase sedimentation in downstream areas. The influence of sediment upon aquatic organisms is well-documented and is considered to be the single greatest pollutant in the Nation's waters. Sediment tends to settle out in downstream areas, and as it does, macrobenthic organisms are covered resulting in their death due to "smothering". This phenomenon results from the impairment of gill functions. Aquatic resources would probably recover from dredging operations after initial disruptions as organisms recolonize dredged areas and areas where sediment is deposited.

The material excavated during dredging operations would require placement and stabilization in upland areas. This could have both short and long-term impacts upon aquatic resources depending upon the management of the disposal area. As spoil is placed upon existing vegetation or the spoil area is cleared to accommodate spoil, detrital production and export of that area is lost. This organic material serves as the basic energy source for benthos and in turn for a large part of the aquatic food chain. If the spoil areas are maintained in any use other than plant production, this impact will be long-term. However, if spoil areas are revegetated and allowed to continue their function of detrital production, impacts to aquatic resources will be short-term.

Clearing of upland areas associated with project construction will have both short and long-term resource implications. Initially, erosion, sedimentation, and turbidity will increase in downstream areas due to clearing. These actions will essentially generate the same short-term impacts alluded to above. Additionally, clearing and maintenance of formerly vegetated areas in any other use will preclude

detrital production of this area. This, in effect will have the same long-term resource impacts as the maintenance of spoil areas discussed above.

A detailed analysis of the impacts of the proposed hydropower generating facilities is not possible due to the lack of specific facility design features. Once that information is provided, a specific analysis will be provided in a supplemental report. Until that time, a general discussion of the resource impacts is provided.

Aquatic resource impacts resulting from the provision of water power-generating facilities depend upon the capacity of the generating facility, the design and location of water intake structures, and the operation schedule for the plant. Facilities of this type have the potential to impinge and entrain large numbers of fish, particularly larval forms, during times when water is being inducted into the turbines. This phenomenon is compounded when generating occurs during critical fish migration periods (i.e., adult migration during spring and vertical migration of larval fish during any 24-hour period).

Intake is also critical to water quality of the receiving body of water. During summer months, many warm water bodies are inclined to thermally stratify resulting in a DO sag in deeper strata waters. If the intake is below this crucial strata, water with depressed DO levels will be inducted through the generating facility and released downstream. This is in effect a discharge of waters of lower quality (depressed DO levels) from the facility.

The operation of a single hydropower unit such as proposed could impact downstream flow conditions, depending on other system operations. Drastic fluctuations in river flow as a result of hydropower "peaking" operations can adversely affect fishery resources through various impacts to water levels. Additional information regarding operation of this facility will be necessary to determine what, if any, impacts occur to fishery resources.

Wildlife Resources

As mentioned above, wildlife habitat in the project area has been altered by urban encroachment and development. Presently, wildlife habitat is limited to a riparian fringe along the Black Warrior River, a large forested tract along Mill Creek, and isolated forested tracts. Resident wildlife populations consist of those species which are adapted to an urban environment and which can exist in close association with human disturbance. Use of the area by transient species is extensive due to the presence of impounded waters, the riparian corridor along the river, and the availability of open fields in association with isolated forested tracts. Land use patterns for the area are expected to remain predominantly urban in nature over the life of the project.

The selected plan will impact wildlife resources of the area. About 90.8 acres will be impacted by clearing for construction and spoil disposal. Construction activities, associated with replacement of the lock and dam, will require that lands necessary will be cleared of all vegetation and root systems grubbed. Spoil disposal areas will be cleared of all vegetation and spoil generated during dredging and construction operations will be placed on the area and stabilized.

Wildlife resource impacts will cover about 229.8 acres of habitat with the selected plan. While this acreage seems relatively small, construction of the features associated with the selected plan will result in the loss of a major portion of the available wildlife habitat in the immediate project vicinity. Most of the habitat loss would be in the spoil disposal area.

Loss of wildlife habitat would be much less if either Alternatives 3 or 4 had been selected or if the combination alternative had been chosen. Construction of the features of Alternative 3 would have destroyed 144.8 acres of wildlife habitat without hydropower and 155.3 acres with hydropower. Construction of Alternative 4 could have resulted in the loss of 111.9 acres of wildlife habitat without hydropower and 140 acres with hydropower. As with the selected plan, the major portion of habitat loss would have been in the spoil disposal area The combination plan would have involved a presently unquantified amount of habitat, somewhere between the figures of alternatives 3 and 4.

As stated above, habitat quality in the project area has been reduced as a result of urban encroachment. Game populations are restricted to small game species. Loss of habitat resulting from project construction will occur primarily in riparian areas important to transient species during their periods of migration, and to other wildlife areas important to resident species. The destruction of wildlife habitat will eliminate nesting habitat for many resident nongame bird populations and destroy habitat important to transient species during spring and fall migration.

DISCUSSION

The selected plan, each of the alternatives, and the combination plan involve adverse impacts to fish and wildlife resources of the area, the magnitude of which depends upon the size of the project area cleared and the amount of spoil material dredged and deposited on the disposal area. Construction and clearing will result in the destruction of forested habitat, open areas and river bottoms. The loss of wildlife habitat is particularly important when considering the limited amount of such area in the immediate project vicinity and the value of such habitat in general. The value of these habitats to

fish and wildlife resources is a result of their productivity. While such habitats sustain fish and wildlife species, they also provide detrital input important to the food chain that sustains fish species.

The effect of the selected plan and the alternatives upon fish and wildlife resources has been discussed in the Project Impacts section of this report. Although some species will be affected more than others, careful planning and implementation of certain mitigative features can reduce adverse impacts to fish and wildlife resources. The following discussion will identify mitigative measures that, if implemented, would compensate for fish and wildlife resources lost as a result of project implementation.

MITIGATIVE MEASURES

Aquatic Resources

Many of the impacts to aquatic resources resulting from clearing, dredging and spoil disposal are the consequence of increased sedimentation and turbidity. Emphasis should be placed on construction techniques that will reduce both the short and long-term effects of these impacts. Obviously, construction activities will involve heavy equipment and removal of vegetative cover. Resulting erosion and sedimentation in the Black Warrior River could become detrimental to aquatic resources. Initiating construction activities during low rainfall periods, stabilizing cleared areas, implementing sedimentation control measures and reducing the amount of vegetative disturbance along stream banks will substantially reduce the effects of erosion and sedimentation on aquatic resources. Additionally, limiting activities during critical fish spawning periods between March 15 and June 30 will reduce aquatic resource losses.

Hydropower production facilities have the potential to impact fishery resources upstream and downstream of Oliver Lock and Dam. Although specific facility design features have not been provided, mitigative features exist that could reduce fishery resource losses and contribute to improved downstream water quality. These features involve the design and location of water intake structures and the discharge. Once specific design and operation features are provided, the FWS will be in a better position to delineate impacts and recommend features in design and operation that will reduce fishery losses and contribute to improved downstream water quality.

Another mitigative feature that could be implemented is the provision of a "greenbelt" corridor along the Black Warrior River. Providing a greenbelt, either through acquisition or easement, and restricting development in the greenbelt would prevent urban encroachment and resulting pollution and habitat degradation. This could provide for the improvement of overall water quality and benefit aquatic species.

Recreational use of aquatic resources could be substantially improved in the project area by providing water access for recreationists. As noted above, access to the tailwater below the existing dam is limited. The nearest boat ramp downstream of the dam is at Moundville 20 miles away. Recreationists must now either launch there or lock through the dam. The selected plan's provision for a boat ramp below the replacement dam on Mill Creek would provide easy access and use of the tailwater area. This would increase fishing oppoprtunities which, according to the Alabama SCORP, there will be a future need for.

Wildlife Resources

Impacts to wildlife resources of the project area would be the result of habitat destruction by construction activities and spoil disposal. Table 1 displays the amount of available wildlife habitat destroyed by implementation of the selected plan and the alternatives. All of the plans would primarily impact small mammals and resident and migratory birds by elimination of riparian habitat through construction activities and destruction of isolated forest tracts and open land by spoil disposal. Without implementing mitigative measures to minimize adverse impacts, small mammals and resident and migratory bird populations inhabiting these areas would be significantly reduced or eliminated.

The implementation of mitigation measures on project lands can reduce the impacts of construction and spoil disposal on wildlife resources. Such measures can maintain habitat values for those species presently inhabiting project lands. Specific habitat-oriented measures directed at minimizing the impact of clearing and spoil disposal on wildlife resources are outlined in the following discussion.

The selected plan would include clearing of 139 acres and its use to contain spoil generated during dredging and construction activities. The combination plan would involve slightly less habitat destruction. The area selected for spoil disposal is presently a mosaic of open meadow and small forested "fingers" of mixed pine-hardwoods and shrubs. Following deposition of the spoil material, this area could provide a diversity of habitat. This action would minimize and somewhat offset habitat losses resulting from construction and spoil disposal. Additionally, those lands presently associated with the existing lock and dam could be managed in a similar way to increase value to wildlife, thereby helping to offset losses.

Revegetation of selected portions of the disposal area by planting hardwood tree species has many advantages over natural revegetation. Increases in wildlife habitat values can be realized quicker and more readily if trees of high value (mast production, cover, nesting, etc.) to wildlife species are planted. Selection of high quality, productive tree species of more value to wildlife than those which might naturally reinvade is enhanced by planting. Density of trees in

the replanted area could be controlled and spaced in such a manner so as to provide for maximum survival, coverage and productivity.

The management of those project lands identified above is an integral part of measures aimed at mitigating and/or minimizing impacts to fish and wildlife resources. Management of lands and waters to be used for fish and wildlife related purposes should be accomplished in accordance with a General Plan developed jointly by the FWS, the Corps of Engineers and the State of Alabama. Such action is appropriate based upon Section 3 of the Fish and Wildlife Coordination Act, the procedures of which have been formalized in a Memorandum of Agreement between the FWS and Corps of Engineers. The General Plan would describe the management responsibilities of the agencies involved. Generally, lands are made available to either the FWS or the state. Should neither the FWS or the State accept the management option, other arrangements become appropriate, including Corps management.

CONCLUSIONS AND RECOMMENDATIONS

The selected plan for Oliver Lock and Dam involves clearing for construction activities and spoil disposal resulting from replacement with a new downstream facility. All of the alternatives analyzed would have both short and long-term impacts on fish and wildlife resources. Aquatic resources will experience predominantly short-term disturbances during construction activities and long-term impacts from loss of detrital production and export. Wildlife populations will be impacted by loss of habitat resulting from construction activities and spoil disposal. Alternative 4 was the least damaging alternative, while the selected plan would entail more substantial losses to wildlife resources as identified above.

In conclusion, it is the obligation of the Federal government to pursue measures to offset project-induced fish and wildlife resource losses. To fulfill this obligation, the following recommendations are presented for incorporation into project plans.

1. Implement measures to minimize fish and wildlife resource impacts resulting from erosion, sedimentation and turbidity, including the following;

   a. Limit all construction activities and dredging to a time period other than the critical fish spawning season between March 15 and June 30.

   b. Limit construction activities during high rainfall periods.

   c. Immediately revegetate all denuded areas.

   d. Minimize vegetation disturbance associated with construction

activities.

2. Spoil disposal area lands should be managed for fish and wildlife production as provided for through the General Plan procedures as identified below.

3. If a new facility is constructed downstream of the existing facility, all project lands remaining associated with the existing facility should be used for fish and wildlife production as provided for through the General Plan procedures as identified below.

4. Revegetate spoil disposal area lands and all other project lands as identified above with hardwood tree species in order to increase habitat value and productivity in these areas.

5. A General Plan as provided for in the Fish and Wildlife Coordination Act, should be developed in cooperation with the FWS, Corps of Engineers and the State of Alabama for lands identified above.

6. This report should be attached to, and made part of, any subsequent submission to Congress requesting or documenting need for any additional funds for planning purposes or construction of the project.

Sincerely yours,

E. R. Roach

for Larry E. Goldman
Field Supervisor

cc: ARD-HR, Atlanta, GA
ADCNR, Montgomery, AL

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August 16, 1983

Mr. Larry E. Goldman
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Dear Mr. Goldman:

The final draft of the Fish and Wildlife Coordination Act Report on the Corps of Engineers Interim Feasibility Report for Oliver Lock Replacement, Black Warrior River, Alabama, has been reviewed as requested in your transmittal letter of August 9, 1983.

We concur with the description of the project area and the involved fish and wildlife resources.

Public waters and surrounding lands near urban areas, such as are involved here, have the potential to support heavy nonconsumptive fish and wildlife use. In addition, the opportunity exist for hunting and fishing use. However, the existing project tailwater and downstream reach has experienced low use due to a lack of public access and boat launching facilities.

Fish and wildlife losses are anticipated with the selected plan and other alternatives. Impacts from erosion of cleared uplands will result in sediment yield and turbidity of the water column. Similar effects will result from dredging operations. Wildlife habitat losses will occur from upland clearing and land inundation. Limited access for public use of fish and wildlife resources associated with the tailrace and downstream reach need correcting if resource use is to receive adequate consideration.

The measures advanced in the Fish and Wildlife Coordination Act Report covering the above concerns are appropriate. We understand that proposed plans include a public access area with boat launching ramp on Mill Creek immediately downstream of the lock and dam. Such facilities are needed to insure public use opportunity of project associated fish and wildlife resources. Inclusion in the final plan of measures advanced to protect the resources and provide for public use will insure consideration of fish and wildlife resources as provided for in the Fish and Wildlife Coordination Act.

The Game and Fish Division of the Alabama Department of Conservation and Natural Resources appreciates the opportunity to provide the above comments. Please keep us advised of project progress. Should changes occur in project design or planning, we would appreciate the opportunity to review and provide comments if warranted.

Sincerely yours,

Charles D. Kelley
Director

CDK/bjc

APPENDIX D

SECTION III

COMMENTS FROM THE GENERAL PUBLIC

The public involvement program for the Black Warrior-Tombigbee Waterway Project consisted of public meetings, public workshops, environmental workshops, public information brochures and fact sheets.

The public involvement plan was designed to proceed in 3 general phases, shown as follows:

a. Determine the problems of the area by meeting with Federal and local governments, navigation interests, civic organizations and the railroad;
b. Consultation with groups to develop various plans to solve problems and needs; and,
c. Work with the public to identify and properly manage the changes which might occur under the various management plans.

Determine the Problems

An initial stage public meeting was held on 22 August 1950 in Tuscaloosa, Alabama to determine the public interest in modifications of the existing navigation project on the Black Warrior-Tombigbee Rivers. The majority of the comments made were in favor of improving the navigability of the rivers. Suggestions were: straightening the rivers; increase channel dimensions to 250-feet by 12-feet; replace existing locks, with the exception of William Bacon Oliver Lock, with 600-foot by 110-foot dimension locks. Other suggestions were to increase flood control along the rivers and develop hydropower resources.

An initial stage public meeting was held on 19 May 1970 in Tuscaloosa to determine the public interest in replacing the existing William Bacon Oliver Lock and constructing cutoffs at critical bends and general widening and developing. The majority of comments made were in favor of replacing the lock with a new lock with dimensions 600-feet by 110-feet. This size, as stated, would be comparable with lock sizes upstream and downstream of Oliver Lock and would, in their perception, prevent Oliver Lock from becoming a bottleneck preventing full utilization of the waterway. Several comments favored cutoffs and channel improvements.

On 28 March 1974 as the draft report presenting replacement alternatives of Oliver Lock was nearing completion, a public meeting was held at Tuscaloosa, Alabama. The purpose of the meeting was to present the alternatives developed and receive public comment on the alternatives. The majority of the comments made were in favor of a new lock, with dimensions of 600-foot by 110-foot, and dam located immediately downstream of the existing lock and dam. Also, a few comments were made expressing a desire [illegible] hydropower, flood control, and channel improvements. A final public meeting was held in Tuscaloosa, Alabama on 12 April 1983 with approximately [illegible] persons attending. Comments made at that meeting were very favorable towards replacement of Oliver Lock with a larger lock.

Copies of the notices announcing these meetings are included in this section. There were three other public meetings held related to the overall BWT study: 29 June 1976 Demopolis, Alabama; 18 October 1977 Mobile, Alabama; and, 20 October 1977 Demopolis, Alabama. Transcripts of all the public meetings are available in the Mobile District office. A public information brochure addressing the overall BWT study including Oliver Lock was released in May 1981 in preparation for several workshops to be held in June 1981. Attendance at those workshops was minimal.

This section also contains comments from the general public made prior to the release of the draft report in March 1983.

CORPS OF ENGINEERS, U. S. ARMY
OFFICE OF THE DISTRICT ENGINEER
MOBILE DISTRICT
2301 GRANT STREET
MOBILE, ALABAMA

26 July 1950

NOTICE OF PUBLIC HEARING ON THE WARRIOR AND TOMBIGBEE RIVERS

The District Engineer has been directed to make a preliminary examination of the Warrior and Tombigbee Rivers pursuant to the following resolution adopted 21 April 1950.

"Resolved by the Committee on Public Works of the House of Representatives, United States, That the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the reports on the Warrior and Tombigbee Rivers, Alabama and Mississippi, submitted in House Document No. 276, 75th Congress, 1st session, and previous reports, with a view to determining whether any modification of the existing navigation project on these streams between Mobile and Birmingham, Alabama, is advisable at this time."

In order that the required report may fully cover the matter, a Public Hearing will be held in the Alabama Power Company Auditorium, located at the corner of Broad Street (5th St.) and 23rd Avenue in Tuscaloosa, Alabama, on Tuesday, 22 August 1950 at 2:00 p.m. (c.s.t.).

For your information, the present project provides an all-year channel 9 feet deep and 200 feet wide, where practicable, from the mouth of Chickasaw Creek at Mobile, Ala. to mile 447.6 on the Sipsey Fork, mile 444.6 on the Mulberry Fork and mile 420.6 on the Locust Fork of the Warrior River. The original project completed in 1915 provided an 8-foot depth by the construction of 17 dams and 18 locks and by dredging and clearing the channel of snags where necessary. Modification of the existing structures has provided the 9-foot depth. In recent years, a new lock and dam has been constructed near Tuscaloosa, Ala. to replace original locks 10, 11, and 12; a cut-off channel 9 feet deep and 150 feet wide and about 1.4 miles long dredged near Sunflower Bend; and, crest gates 12 feet high placed on top of dam 17. Approved work that remains to be completed on the project consists of the lengthening of the spillway at lock 1 and the construction of a new lock and dam near Demopolis to replace existing locks 4, 5, 6, and 7.

All interested parties including representatives of Federal, State, County, and municipal agencies, those of commercial, industrial, civic, highway, railroad, and waterway transportation interests, and property owners concerned are invited to be present or represented at the above time and place. They will be afforded full opportunity to express their views concerning the character and extent of the improvement desired and the need and advisability of its execution. Sponsors of the improvements desired and the economic justification of the undertaking. Opposing interests are also urged to state the reasons for their position.

Oral statements will be heard but for accuracy of record all important facts and arguments should be submitted in writing, in quadruplicate, as the records of the hearing will be forwarded for consideration by the Department of the Army. Written statements may be handed to the undersigned at the hearing or mailed to him beforehand.

Please bring the foregoing to the attention of persons known to you to be interested in the matter.

/s/
W. K. WILSON JR.
Col., Corps of Engineers
District Engineers

U. S. ARMY ENGINEER DISTRICT, MOBILE
CORPS OF ENGINEERS
P. O. BOX 2288
MOBILE, ALABAMA 36601

22 April 1970

NOTICE OF PUBLIC HEARING ON THE BLACK WARRIOR-TOMBIGBEE WATERWAY PROJECT, ALABAMA

Pursuant to a resolution adopted 21 April 1950 by the Public Works Committee, United States House of Representatives, which Congressional authority is stated on the reverse side hereof, the District Engineer has been directed to prepare a survey report on the Black Warrior-Tombigbee Waterway project to determine if any modifications thereof are advisable.

For your information, the existing Federal project provides for a 9- by 200-foot canalized channel from Mobile to the vicinity of Birmingham. The improvement presently includes six locks and dams, of which one lock (Bankhead) is double lift. Four locks have inside chamber dimensions of 110 by 600 feet; one (Oliver at Tuscaloosa) has dimensions of 95 by 460 feet; and one (Bankhead) is 52 by 285 feet (double lift). A replacement lock for Bankhead (single lift, 110 by 600 feet) has been authorized and first construction funds were made available in FY 1970.

Modifications which may be considered consist of, but are not limited to, replacement of the 95- by 460-foot William Bacon Oliver Lock at Tuscaloosa with a lock having chamber dimensions of 110 by 600 feet comparable to others on the waterway, provision of cutoffs at critical bends, and general widening and deepening.

In order that the required report may fully cover the matter, a public hearing will be held in BALLROOM NO. 3 AT THE STAFFORD HOTEL, TUSCALOOSA, ALABAMA, AT 1:30 P.M., ON TUESDAY, 19 MAY 1970.

All interested parties are invited to be present or represented at the public hearing, including representatives of Federal, State, county and municipal agencies, and those of commercial, industrial, civic, highway, railroad, and water transportation interests, and property owners concerned. They will be afforded full opportunity to express their views pertinent to the project in question. Sponsors of the project are urged to present factual material bearing upon the economic justification for the project. Opposing interests, if any, are also urged to state the reason for their opposition.

Oral statements will be heard but for accuracy of record all important facts and arguments should be submitted in writing, in quadruplicate. Written statements may be handed to the undersigned at the hearing or mailed to him beforehand.

Please bring the foregoing to the attention of persons known to you to be interested in the matter.

Paul D. Sontag

PAUL D. SONTAG
LTC, Corps of Engineers
Acting District Engineer

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2288
MOBILE, ALABAMA 36628

REPLY TO
ATTENTION OF: SAMEN-PD

28 February 1974

ANNOUNCEMENT OF PUBLIC MEETING
ON
BLACK WARRIOR-TOMBIGBEE WATERWAY PROJECT, ALABAMA

MEETING TO BE HELD AT 7:00 P.M.
ON 28 MARCH 1974
IN BALLROOM 3, RAMADA INN DOWNTOWN,
TUSCALOOSA, ALABAMA

The Corps of Engineers is conducting survey studies pursuant to a resolution adopted 21 April 1950 by the Public Works Committee, United States House of Representatives, to determine the various alternatives, if any, that can be justifiably taken to improve the existing waterway. An initial public meeting on this subject was held in Tuscaloosa 19 May 1970.

The existing Federal project provides for a 9- by 200-foot channel from Mobile to the vicinity of Birmingham. The improvement presently includes six locks and dams, of which one lock (Bankhead) is double-lift. Four locks have inside chamber dimensions of 110 by 600 feet; one (Oliver at Tuscaloosa) has dimensions of 95 by 460 feet; and one (Bankhead) is 52 by 285 feet. A single-lift replacement lock for Bankhead, 110 by 600 feet, is presently under construction and should be opened to traffic in 1975.

Our studies have progressed to the point where practicable alternative solutions have been defined. The alternatives include replacement of the present William Bacon Oliver Lock and Dam with a new structure consisting of a 110- by 600-foot lock, and a dam containing both a gated and fixed crest spillway. Three alternative sites were investigated for the replacement dam and lock. Also, the possibility of replacing the existing lock with one landward of the present site, and retaining the existing dam, was investigated. These alternatives are shown on the attached map. An environmental assessment of these alternatives is included with this announcement. The purpose of the meeting is to present for consideration and general reaction, information on these alternative means for providing navigation improvements for the

authorized project. Details of the considered alternatives will be discussed at the public meeting.

Separate studies were made of 11 possible sites for cutoffs and easement of bends downstream of Tuscaloosa. More detailed investigations will have to be made of these sites before further consideration can be made as to their merits. If study results on any of these cutoffs seem favorable, another public meeting will be held to present the findings and to obtain public comment.

All interested individuals, groups, and agencies are invited and urged to be present or represented at this meeting. Everyone will be given an opportunity to express his views and furnish specific data on all aspects of the study, including technical, economic, social, ecological, and environmental material. Statements should be supported by factual material insofar as practicable.

For accuracy of record, all important facts and statements should be submitted in writing. Written statements may be handed to the presiding officer at the meeting, or may be mailed beforehand to:

District Engineer
U. S. Army Engineer District, Mobile
P. O. Box 2288
Mobile, Alabama 36628

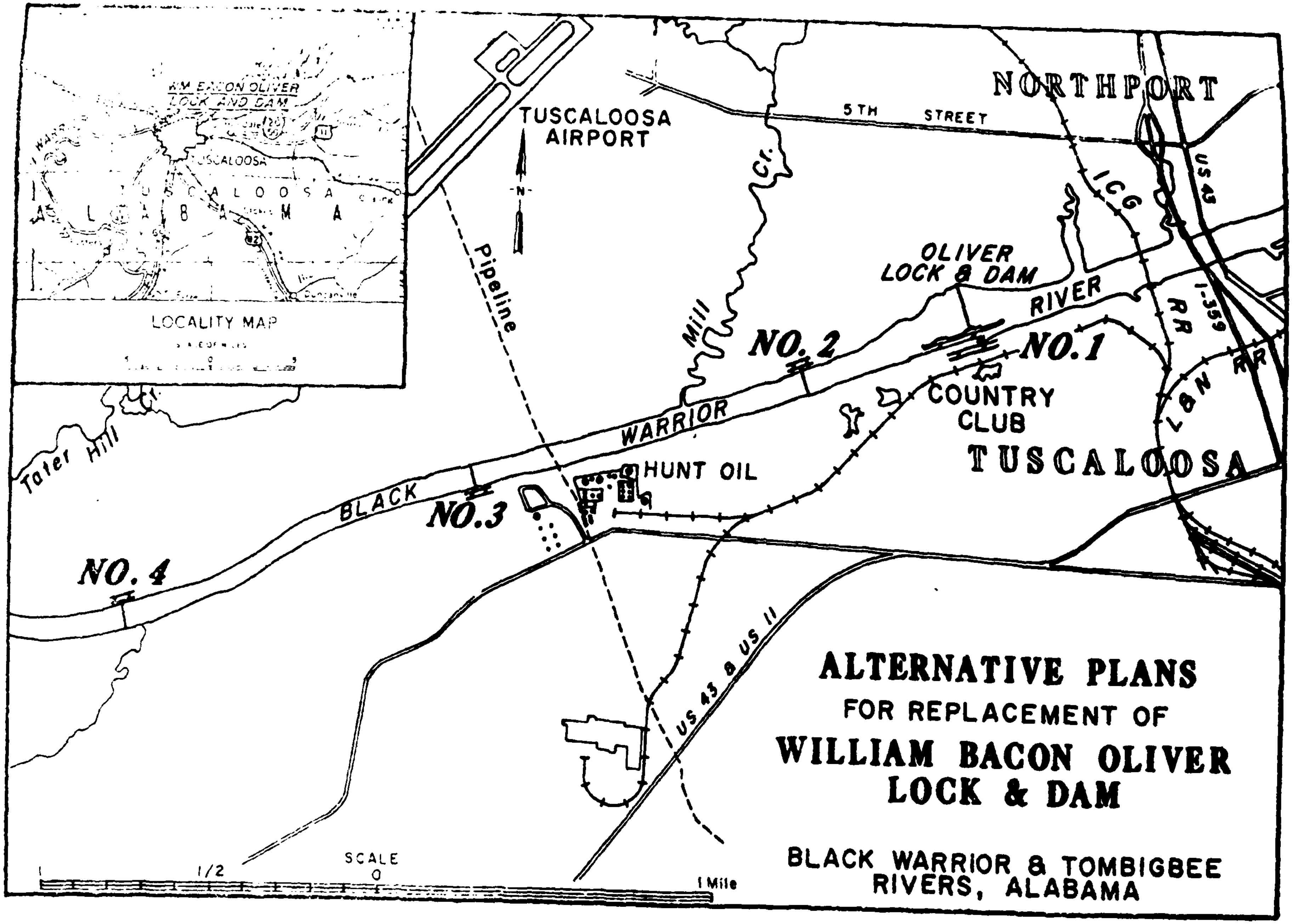
Statements so mailed should indicate that they are in response to this announcement. All statements, both oral and written, will become part of the official record on this study and will be made available for public examination unless specified as confidential.

Full consideration will be given to the views presented prior to making a recommendation to higher authority. However, this cannot be taken as an indication that the Federal Government will undertake any improvements or programs. Although the study may result in recommendations for undertakings by the Federal Government, their accomplishment will depend upon further funding by the Congress.

Please bring this announcement to the attention of anyone you know who is interested.

DRAKE WILSON
Colonel, CE
District Engineer

2 Incls
1. Map
2. Environmental considerations


ALTERNATIVE PLANS
FOR REPLACEMENT OF
WILLIAM BACON OLIVER
LOCK & DAM
BLACK WARRIOR & TOMBIGBEE
RIVERS, ALABAMA
LOCALITY MAP
WM BACON OLIVER
LOCK AND DAM
TUSCALOOSA
TUSCALOOSA AIRPORT
N
Pipeline
NORTHPORT
5TH STREET
US 43
ICG
RR
I-359
L&N RR
OLIVER
LOCK & DAM
RIVER
NO.1
NO.2
NO.3
NO.4
Mill Cr.
COUNTRY
CLUB
TUSCALOOSA
WARRIOR
BLACK
HUNT OIL
Tater Hill
US 43 & US 11
SCALE
1/2
0
1 Mile

ALTERNATIVE PLANS
FOR REPLACEMENT OF
WILLIAM BACON OLIVER
LOCK AND DAM

ENVIRONMENTAL CONSIDERATIONS

A. Environmental Setting.

The Black Warrior-Tombigbee River Waterway basin includes the drainage area of all of the Black Warrior River and the greater portion of the Tombigbee River. Only the upper reaches of the Tombigbee lie within the State of Mississippi; hence, the basin as defined for most Waterway purposes is restricted to the confines of Alabama. The basin extends southerly from the divide of the Tennessee River in northwest Alabama and is bounded on the east by basins of the Coosa, Cahaba, and Alabama rivers and on the west by the upper Tombigbee and the Escatawpa drainage systems. The Black Warrior River is formed by the junction of the Locust and Mulberry forks approximately 20 miles west of Birmingham and flows southwestward 45 miles to Tuscaloosa and thence southward 120 miles to its junction with the Tombigbee River at Demopolis 216 miles above Mobile. From its head above the John Hollis Bankhead Lock and Dam, the Black Warrior River falls 182 feet in four pools to Demopolis and from Demopolis, the Tombigbee falls an additional 76 feet in two pools, providing a total lift of 258 feet over a waterway distance of 463 miles from the point of origin to the confluence with the Alabama River some 45 miles north of Mobile.

The overall basin lies in two distinct physiographic provinces which exhibit both topographic and geologic contrasts. Soil types, the nature of vegetation, land-use patterns, economic factors, and the general environmental setting are influenced by the contrasting geologic and physiographic elements. The northern part of the basin is situated in the Cumberland Plateau, a subdivision of the Appalachian Plateau physiographic province. The Plateau exhibits topographic features characteristic of a submaturely dissected upland developed largely upon massive sandstones and indurated shales of Paleozoic geologic age. The rocks are warped gently into a broad synclinal fold interrupted in the eastern sector by sharp anticlinal folds exposing older Paleozoic rocks. Elevations range from 1500 feet in the north to 500 feet in the south where Paleozoic strata gradually dip beneath sedimentary rocks of the East Gulf Coastal Plain sector of the Coastal Plain Province.

Separating the Coastal Plain from the Appalachian Plateau is the Fall Line, a dissected upland belt with a few broad, flat ridges separated by valleys ranging from 100 to 200 feet in depth. The Fall Line Hills, attaining a maximum width of 50 miles in western Alabama, occupy a zone of flexure where falls and rapids develop in streams as they descend from resistant Paleozoic rocks to the less resistant sandstones and clays of the Coastal Plain. The East Gulf Coastal Plain is underlain by sedimentary rocks of Mesozoic and Cenozoic geologic ages that dip toward the south or southwest

Incl 2

at rates of 20 to 45 feet per mile. Topographically, the coastal Plain may be described as a low, gently rolling surface characterized by arcuate and sub-parallel valleys and cuestas reflecting differential resistance to erosion of the sediments forming the plain. Siltstone, sandstone, buhrstone and poorly indurated clay gravels form the cuestas whereas the intervening valleys are generally underlain by chalk, marl, clay, and friable sandstones. To the south of the Fall Line Hills is a series of southeasterly trending hilly belts termed respectively the Black Prairie Belt, Chunnennuggee Hills, Flatwoods District, Southern Red Hills, Buhrstone Hills, and Lime Hills District. Elevation of the Coastal Plain ranges from approximately 500 feet above sea level at the Fall Line to about 40 feet at the south extremity of the project area. Inconspicuous anticlinal folds and faults break the otherwise uniform structural attitude of the Coastal Plain sedimentary rocks.

Oliver Lock and Dam is located slightly downstream of the point where the Black Warrior River begins to flow over Coastal Plain sediments and leaves the rocks of the Cumberland Plateau. In Lake Oliver the river valley changes from the typical mature erosional stage to a broad valley with numerous stream meanders and characteristics of an older stage of development. The Coker Formation of the Tuscaloosa Group (Upper Cretaceous age) consisting of massive, porous sandstones and varicolored clay-shales overlaps Pottsville sandstones and shales in this area. Pleistocene terrace sands and gravels and a silty red plastic clay subsoil characterize the upstream portion of Lake Oliver. A variety of sandy loams of the Greenville-Faceville association suitable for agriculture, pasture, and timber growth develop in the area near Oliver Lock and Dam.

Oliver Lock and Dam is located 346.3 river miles above Mobile, Alabama, within the corporate limits of the City of Tuscaloosa. The dam forms Lake Oliver which has an area of 790 acres, a length of 8.8 miles, and a storage volume of 12,400 acre-feet at normal pool elevation 123. Lake Warrior is located downstream of Oliver Lock and Dam, and has an area of 7,800 acres, a length of 82.5 miles, and a storage volume of 49,000 acre-feet at normal pool elevation 95.

The flow in the Black Warrior River at Tuscaloosa is governed by releases from upstream projects. All flow leaving Lake Oliver is passed over the fixed crest spillway. The main tributaries of the Black Warrior River in the vicinity of Tuscaloosa are Hurricane Creek and North River. Hurricane Creek has an average flow of 146 cfs (1952-1969) and a median 7-day low flow of 8 cfs (1939-1962). North River has an average flow of 527 cfs (1951-1968) and a median 7-day low flow of 27 cfs (1939-1962). The Black Warrior River at Tuscaloosa has an average flow of 7,505 cfs (1894-1902,1928-1971) and a median 7-day low flow of 220 cfs (1939-1962).

The Alabama Water Improvement Commission has established use classifications for the Black Warrior River. The river near Tuscaloosa is classified as follows:

Holt Lock and Dam to Hurricane Creek - fish and wildlife

Hurricane Creek to Oliver Lock and Dam - agricultural and industrial water supply

Oliver Lock and Dam to Warrior Lock and Dam - fish and wildlife.

All tributary streams near Tuscaloosa are classified for fish and wildlife with the exception of that portion of North River above the Tuscaloosa water supply dam which is classified for public water supply.

The lower standard for the majority of Lake Oliver emphasizes the magnitude of wastes entering this reach. Six industrial plants in the Holt-Tuscaloosa area, none of which provides adequate waste treatment at present, contribute additional pollutants to the river before the stream has an opportunity to recover from previous loadings. One coal washing operation discharges treated waste into Hurricane Creek. The present domestic waste loading consists of 0.40 million gallions per day (MGD) of adequately treated effluent from the City of Northport. The approximately 4 MGD discharge from Tuscaloosa's primary treatment plant enters the river 21 miles downstream from Oliver Lock and Dam.

The average annual rainfall in the area is approximately 54 inches which is well distributed throughout the year. There is some seasonal variation with about 41 percent occurring during the 4-month wet period of January through April and about 18 percent during the 3-month dry period of September through November.

The average annual temperature of the area is 62 degrees F. The normal monthly temperature ranges from about 46 degrees F in January to about 82 degrees F in July. A minimum of -17 degrees F and a maximum of 110 degrees F have been recorded in the area. The normal frost-free period of seven months lasts from April to October.

The prevailing winds are from the north in the fall and winter, and from the south in the spring and summer. March is the most windy month with an average speed of 8.5 mph while October has the least wind with an average speed of 4.4 mph. The average wind speed for the year is 6.5 mph.

A number of historical and archeological sites exist along the Black Warrior River. Within the City of Tuscaloosa are Capitol Square and the Old Tavern, several homes of antebellum vintage, and structures located on the campus of The University of Alabama. Indian sites in Tuscaloosa County include Tuskaloosas on the Black Warrior River, an aboriginal village first recorded in 1707. None of the sites would be affected by the replacement of Oliver Lock and Dam.

Oliver Lock and Dam is located in Tuscaloosa County which has a total area of 857,600 acres. The land use breakdown of the county in 1964 was: forest land, 690,000 acres; crop land, 44,964 acres; pasture land, 87,008 acres; other farm land, 6,410 acres; and land not in farms or forest, 29,218. The forests in the county are made up of approximately 40 percent softwood and 60 percent hardwood. Cotton, corn, hay, and cattle are the main agricultural enterprises in the county.

The total population of Tuscaloosa County was 76,036 in 1940 and 116,029 in 1970. Tuscaloosa and Northport are the major cities in the county and had populations in 1970 of 65,773 and 9,435, respectively. Approximately [illegible] percent of the county's population lived in the Tuscaloosa-Northport area in 1970.

The industrialization of Tuscaloosa County has resulted in higher incomes for the residents. The 1970 census figures indicate median family income for Tuscaloosa County and the State of Alabama of $7,435 and $7,266, respectively.

Vegetatively, the project area is located within the general intergradation of the northernmost limit of the southern floodplain forest and the oak-hickory-pine forest. The forest types typical of the oak-hickory-pine complex occur on the higher, drier slopes with representative plants of the southern floodplain forest in the swamp areas and floodplain along the Black Warrior River.

The oak-hickory-pine forest covers a large portion of Alabama. In its undisturbed state, this forest is thought to have consisted primarily of hardwoods with single or small clusters of pines intermixed. Scattered stands of pines are a common feature of this area, and in the absence of disturbances these stands are eventually replaced by a mixed oak-hickory-pine forest. Dominant species of this forest include bitternut, mockernut, and pignut hickories, white oak, post oak, northern and southern red oak, loblolly and shortleaf pine. On drier ridges, Virginia pine and scarlet oak become dominant, whereas on wetter sites yellow popular, Shumard oak, willow oak, live oak, and bay magnolia occur frequently. The oak-hickory-pine forest is very rich in tree species, but many are limited in distribution.

Downstream of Oliver Lock and Dam the Black Warrior River has a well developed southern floodplain forest that remains distinct as the river flows through different vegetative zones. This forest is typically dominated by tupelo gum, bald cypress, pecan, and several species of oak, particularly Shumard oak, overcup oak, water oak, willow oak, laurel oak, and swamp chestnut oak. Other species that are common in this forest include swamp privet, red bay, water elm, American elm, cabbage palm, sugarberry, and rattan vine.

Water oak, willow oak, sycamore, river birch, eastern cottonwood, black willow, red mulberry, planer tree, ironwood, American elm, and hackberry are common trees along the river bank in the immediate project area. Loblolly and shortleaf pine, sweetgum, beech, laurel oak, and mimosa occur on the high slopes and bluffs along the river. The largest of these trees are about [illegible] feet in height and 2.5 feet in diameter. Various shrubs, vines and brambles occur as understory vegetation. Significant stands of marketable pine timber are absent.

The banks of the Black Warrior River near the City of Tuscaloosa are the home of two of the rarest plants in the world--Croton alabamensis and Nevusia alabamensis. Croton alabamensis was first discovered along the Cahaba River in 1877 and is known to exist presently at only a few localities in Tuscaloosa and Bibb counties along the Black Warrior and Cahaba rivers, respectively. Nevusia alabamensis, a monotypic species, is also a shrub. It was first discovered in 1957 along the left bank of the Black Warrior River just above the City of Tuscaloosa.

Small populations of the southern gray squirrel, cottontail rabbit, and opossum occur in the project area. Smaller mammals are present in the open disturbed areas. Other mammalian species which may be present are armadillo, chipmunk, gopher, beaver, fox, raccon, weasel, mink, skunk, otter, and bobcat. The smaller mammals are more common in the open areas and along the forest edge. The whitetail deer may be a frequent visitor to the area.

The bird population of the Black Warrior-Tombigbee river system is both extensive and varied. This includes birds which utilize as habitats the impounded waters, shallow waters, and mud flats and sand bars. Some 100 or more bird species including game birds and rare species inhabit the basin. The common loon, double-crested cormorant, the mergansers, and northern phalarope are particularly adapted to the deep-water impoundments. Transient and rarely-seen species are: bald eagle, golden eagle, sharp-shinned hawk, Cooper's hawk, osprey, peregrine falcon, swallow-tailed kite, Mississippi kite, and sandhill crane. Game birds in the basin include several varieties of geese and ducks, among them: Canada goose, mallard, pintail, green-winged teal, and wood duck. It is highly probable that many of these birds rarely occur in the project area or are only transient members of the bird population in the vicinity of the present dam.

Turtles, lizards, and snakes comprise the bulk of the reptilian fauna in the project area. Few snakes aside from those of the genus Natrix, the cottonmouth, and copperhead are closely associated with water. Salamanders, frogs and toads comprise the amphibian population along the river.

Due to the close proximity of human activities (the City of Tuscaloosa on the left bank and the City of Northport and Tuscaloosa Airport on the right bank) poor quality wildlife habitat is found in the project area. This fact is reflected in that only 1,562 hunting visitations were reported for the year 1970 (which is representative of the past four years) for Lake Oliver. This compares with 10,501 hunter visitations for Lake Warrior and 4,355 for Holt Lake. The majority of the hunting visitations at Lake Oliver occurred on the river above the urban centers of Tuscaloosa and Northport.

According to William F. Smith-Vaniz's Freshwater Fishes of Alabama,

1?? species of fishes are known to occur in the Black Warrior River system with nine other species probably being found in the river based on known distribution and/or habitat requirements of these species. Some 15 species, although generally classified as sport species, have commercial value, and 12 forage fishes are adapted to the impoundments of the reservoirs. Commercial varieties include buffalo, catfish, sunfish, crappie, drum, and others. Principal species of sport fish are: bluegill bream, largemouth bass, salmoides; spotted bass and white crappie. Channel catfish and blue catfish are taken on trot lines. Among the forage fishes, minnows, shiners, chub and shad are common. The gizzard shad is generally abundant. The longnose and shortnose gars, the bowfin and the American eel are of limited commercial or sport value. The American eel spawns in salt water, and generally does not migrate above the dams.

Lake Oliver is not heavily fished due to poor water quality created by industrial and domestic wastes. The area immediately below the present dam received the heaviest fishing pressure in the project area. The utilization of Lake Oliver for fishing is summarized in the following figures for the year 1970, representative of the past four years (Lake Warrior downstream and Holt Lake upstream are included for comparative purposes):

	Warrior	Oliver	Holt
Fishing Visitations	201,549	26,974	120,995
Commercial Projects	3	0	10
Number Taken	23,400	0	78,000
Game Fish Harvested	162,075	43,220	140,465

Channel catfish, blue catfish, and carp are the principal commercial species commonly caught.

The species composition and number of species of the molluscan fauna presently inhabiting the streams of the Black Warrior-Tombigbee drainage system is not known with certainty, although 48 species of native mussels (Pelecypoda) and 15 species of snails (Gastropoda) have been noted in the past as inhabitants of the waterway. Some 12 species of crayfish (Crustacea) have been reported from drainage system. Some of the shellfishes have probably been extirpated as a result of the impoundments and/or the attendant pollution. This would be expecially true for the waters comprising Lake Oliver and that reach of the Black Warrior below the present dam.

3 Assessment of Adverse Environmental Effects.

The following tabulation is a listing of the adverse environmental effects that would occur with implementation of the project. The adverse effects have been established for each of five alternatives: Alternative I - Replacement lock located landward of existing lock; Alternatives II, III and IV - Replacement locks and dams located .5, 1.6, and 2.6 miles downstream from the existing lock and dam, respectively; and Alternative V - No improvement with continuation of present conditions.

ALTERNATE PLANS FOR REPLACEMENT OF WILLIAM BACON OLIVER LOCK AND DAM

ASSESSMENT OF ADVERSE ENVIRONMENTAL EFFECTS

ALTERNATIVE I	ALTERNATIVE II	ALTERNATIVE III	ALTERNATIVE IV	ALTERNATIVE V
30 acres of land would be committed to Federal ownership entailing a loss of tax revenue for Tuscaloosa County. Temporary degradation of water quality and aesthetics during construction	130 acres of land would be commited to Federal ownership entailing a loss of tax revenue for Tuscaloosa County. 130 acres of poor quality wildlife habitat would be lost. Temporary degradation of water quality and aesthetics during construction. Temporary damage to fisheries caused by blasting to remove old dam Existing farm and forest land would be lost, including approximately 5 acres of precipitous river bank which would be permanently inundated by the new pool The lower 700 feet of Mills Creek would be altered by the proposed lock structure.	140 acres of land would be committed to Federal ownership entailing a loss of tax revenue for Tuscaloosa County 140 acres of moderately productive wildlife habitat would be lost Temporary degradation of water quality and aesthetics during construction. Temporary damage to fisheries caused by blasting to remove old dam Existing farm and forest land would be lost including 15 acres of precipitous river bank which would be permanently inundated by the new pool	150 acres of land would be commited to Federal ownership entailing a loss of tax revenue for Tuscaloosa County 150 acres of moderately productive wildlife habitat would be lost Temporary degradation of water quality and aesthetics during construction Temporary damage to fisheries caused by blasting to remove old dam Existing farm and forest land would be lost including 25 acres of precipitous river bank which would be permanently inundated by the new pool	Navigation will not be improved Slower navigation oriented commercial growth

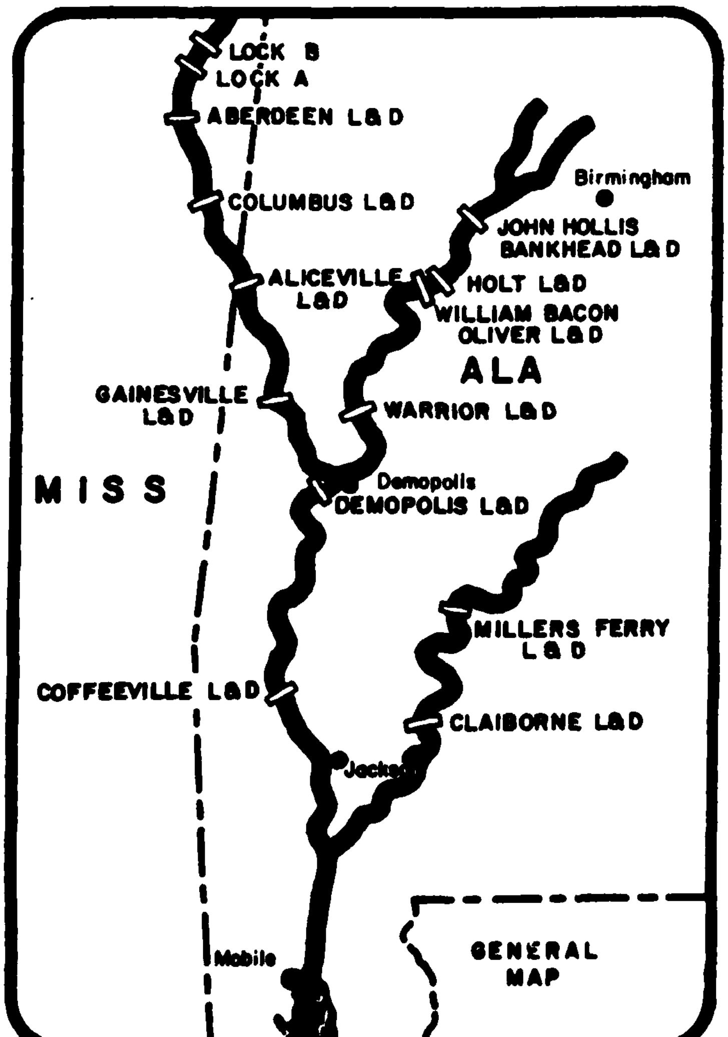
Black Warrior - Tombigbee Rivers Feasibility Study

PUBLIC INFORMATION BROCHURE

U.S. Army Corps of Engineers, Mobile District
P.O. Box 2288 Mobile, AL 36628

MAY 1981

Feasibility Study Continuing



The U. S. Army Corps of Engineers, Mobile District is continuing a study of the Black Warrior-Tombigbee Rivers (BWT). The study has identified numerous water resource problems and needs and public concerns pertaining to the future development of the BWT.

STUDY PURPOSE

The study is intended to provide information that will aid in the planned development of the BWT from the Federal, State and local viewpoints. Careful planning is necessary to insure that a balance is maintained between economic development and the human and natural environment.

STUDY AUTHORITY

A House Public Works Committee resolution adopted 21 April 1950 requested a review of reports to determine the advisability of modifications of the existing navigation project on the Black Warrior and Tombigbee Rivers between Mobile and Birmingham, Alabama. On 19 April 1976, the Subcommittee on Public Works, Committee on Appropriations, United States Senate and House of Representatives were advised that the Corps proposed to expand the scope of the study to address the needs and effects of the combined navigation traffic of the Tennessee-Tombigbee Waterway (TTWW) and BWT on the portion of the Tombigbee River below Demopolis, Alabama. Concurrence in the proposal was obtained from the Senate on 23 April 1976 and from the House on 4 May 1976.

THE UNIVERSITY OF ALABAMA
COLLEGE OF ARTS AND SCIENCES
UNIVERSITY, ALABAMA 35486
PHONE: (205) 348-7774

ARCHAEOLOGICAL RESEARCH

DRAWER 8A

March 11, 1974

District Engineer
U.S. Army Engineer District, Mobile
P.O. Box 2288
Mobile, Alabama 36628

Dear Sir:

It has come to my attention that a meeting has been set on March 28 to discuss possible plans for the replacement of the William Bacon Oliver Lock and Dam as well as other discussions pertaining to navigational cutoffs at selected locations downstream of Tuscaloosa.

The primary interest of this Office is to ascertain the possibility of destruction of archaeological sites which may be directly or indirectly affected by these proposed construction activities. I would appreciate maps and other pertinent data which would aid in our archaeological assessment of these proposed construction areas.

I would like to have this information if at all possible prior to the March 28 meeting.

Thank you for your consideration of this matter.

Sincerely,

Carey B. Oakley

Carey B. Oakley, Director
Office of Archaeological Research

CBO/gc

THE UNIVERSITY OF ALABAMA
COLLEGE OF ARTS AND SCIENCES
UNIVERSITY, ALABAMA 35486
PHONE: (205) 348-7774

ARCHAEOLOGICAL RESEARCH DRAWER DA

March 26, 1974

Mr. Ralph W. Mueller, Chief
Planning and Reports Branch
Corps of Engineers
P.O. Box 2288
Mobile, Alabama 36628

Dear Mr. Mueller:

On March 22, 1974 an archaeological survey of the area which would be affected by the construction of a replacement dam for the existing William Bacon Oliver Lock and Dam was conducted by staff members from the Office of Archaeological Research. The purpose of this survey was to ascertain if any archaeological or historical sites would be directly or indirectly affected by the construction of the replacement dam. Survey activities were restricted to Site no. 2 which was indicated as the site most suitable for the new dam.

The results of this archaeological survey, as well as research through existing archaeological site files, show that there are no significant archaeological or historical sites located within the immediate affected area of the proposed dam site no. 2.

I trust this information may be of help to you.

Sincerely,

Carey B. Oakley

Carey B. Oakley, Director
Office of Archaeological Research

CBO/gc

STATE OF ALABAMA
ALABAMA HISTORICAL COMMISSION
725 MONROE STREET
MONTGOMERY, ALABAMA 36104

WARNER FLOYD
UTIVE DIRECTOR

TELEPHONE NUMBER
832-6622

May 2, 1975

Mr. Willis E. Ruland
Acting Chief
Environment and Resources Branch
Department of the Army
Mobile District, Corps of Engineers
P. O. Box 2288
Mobile, Alabama 36628

Dear Mr. Ruland:

Thank you for the opportunity to comment on the alternative sites for replacement of the William Bacon Oliver Lock and Dam in Tuscaloosa. The Alabama Historical Commission prefers alternative site No. 1 which is in the area of the present lock and dam and has no adverse affect.

Alternative site No. 2, if selected, would be on the site of Black Warrior's Town, the 18th century Creek village on the banks of the Black Warrior River. This large Indian village of about fifty cabins and a long house was burned October, 1813 during the Creek War by Colonel John Coffee and his Tennessee regiment. Davy Crockett was a scout in Coffee's command and mentioned this incident in his 1834 autobiography. An Alabama Historical Association marker has been placed on Highway 11, south of the site, denoting this famous area.

Alternative sites Nos. 3 and 4 are located near the Smelser House, built in 1830 and still a thriving river plantation. The house is closest to alternative plan No. 4, approximately 8/10 of a mile away. If this alternative is selected it could have some effect on this landmark for which the Alabama Historical Commission is preparing forms for nomination to the National Register of Historic Places.

Please send us your basic data relating to archeaological surveys and salvage conducted in the area to prepare us for the forthcoming request for our comments from the Advisory Council on Historic Preservation.

Sincerely,

W. Warner Floyd

W. Warner Floyd

GCB

The Tuscaloosa County Historical Preservation Authority

POST OFFICE BOX 1776
TUSCALOOSA, ALABAMA 35401

May 15, 1975

Mr. Jack Stell
Alabama Historical Commission
725 Monroe Street
Montgomery, Alabama 36104

Dear Jack:

Enclosed is material from Matthew P. Clinton's book, Tuscaloosa Alabama, Its Early Days 1816-1865, relating some of the history of Black Warrior's Town, which was on the Warrior River here in Tuscaloosa. The information includes the location, size, and many of the important events that took place in this Creek village, thereby helping to establish the true signifiance of the village site. Note the famous personalities whose lives became involved in events surrounding Black Warrior's Town: Alabamians like George Strather Gaines, Colonel John Coffee and Colonel John McKee; frontiersmen like Davy Crockett; and Indians chiefs like Tecumseh and Pushmataha. Although not a great battle, the burning of this Creek outpost during the Creek War was essential to the victory over the unfriendly tribes of Alabama.

The archaeological importance of the Black Warrior's Town site has not yet been investigated by local historians due to the great cost involved. It is amazing that the site has remained vacant for this length of time, especially when the industrial potential of the river front land is considered. From the historical standpoint, Black Warrior's Town, with its wealth of Indian heritage, can have a meaningful future as a developed historical site.

I hope this answers all questions concerning the history of Black Warrior's Town and Tuscaloosa County's feelings about the importance of the area. If I can be of any more assistance in this matter, please let me know.

Yours truly,

Gregg

Gregory B. Free

Enclosure

cc: Charles G. Summersell

GBF/msb

THE UNIVERSITY OF ALABAMA
MUSEUM OF NATURAL HISTORY
MOUND STATE MONUMENT
MOUNDVILLE, ALABAMA 35474

ARCHAEOLOGICAL MUSEUM

March 17, 1975

WEP

Mr. Willis E. Ruland, Acting Chief
Environment & Resources Branch
Mobile District Corps of Engineers
P.O. Box 2288
Mobile, Alabama 36628

Dear Mr. Ruland:

We have received your letter of March 3, 1975 concerning the presence or absence of archaeological sites in areas slated for the replacement of the William Bacon Oliver Lock and Dam in Tuscaloosa Coutny, Alabama.

An on-site review of the area of Alternate Plan 2 revealed no archaeological sites. Alternate Plan 2 was indicated to our representative, during his March 5th visit to the area, as being the selected location for the replacement of the Oliver Lock and Dam. This information was received from a Corps representative from your Tuscaloosa office. A field check of that area on both sides of the Warrior River was made that same day and no evidence of archaeological sites was found. If for any reason Alternate Plan 2 is not used and any other areas are selected, we would need to be notified so we could examine these areas.

We appreciate your contacting us prior to the beginning of construction of the new lock and dam.

With kindest regards

Sincerely,

David L. DeJarnette

David L. DeJarnette
Curator and
Associate Professor

DLD:jgn

Warrior-Tombigbee Development Association
Executive Vice President Clarence M. Kilian
202-204 Mims Bldg., 512 Eighteenth Street North
Birmingham, Alabama 35203
Phone 252-8507

July 29, 1975

Colonel Drake Wilson
Mobile District Engineer
U. S. Army Corps of Engineers
P. O. Box 2288
Mobile, Alabama 36628

Dear Drake:

Thanks so much for setting up the conference with Larry Green and his associates. While the resulting delays stemming from the re-study of a study, which I am sure initially was well done, are disappointing, perhaps in the long run time will be saved. Hopefully the Lock 26 controversy will be resolved in such a way so that it will be known definitely whether or not William Bacon Oliver Lock must have a special authorization or comes under the replacement authorization in the 1909 Act.

Working with you and your group has been a distinct pleasure and I am sure that has been the experience of others with business with the Mobile District. The award of the Propeller Club last week therefore seems to me to be all the more merited.

Sincerely,

C. M. Kilian
Executive Vice President

CMK/br

RAY D. BASS
HIGHWAY DIRECTOR

STATE OF ALABAMA
HIGHWAY DEPARTMENT

MONTGOMERY, ALABAMA 36104
832 - 5413

August 25, 1975

Mr. Bob Meader
Planning Division
U. S. Corps of Engineers
P. O. Box 2288
Mobile, Alabama 36628

Re: Tuscaloosa Area Transportation Study

Dear Mr. Meader:

This letter is in response to your telephone request of August 22, 1975, concerning traffic counts and forecast traffic in the Tuscaloosa area.

Present traffic counts indicate that approximately 18,700 vehicles cross the Hugh Thomas Bridge per day and 27,520 vehicles cross the 82 By-Pass Bridge each day. These are average daily traffic counts and do not reflect weekend or holiday traffic.

The adopted long-range transportation plan for the Tuscaloosa area is currently undergoing a complete reevaluation. The forecast year for this plan reevaluation is the year 2000. The West Alabama Planning and Development Council developed land use and socio-economic forecasts for incorporation into the transportation planning process. Trips were generated based on this land use data and assigned to the currently recommended plan, and the results of this traffic assignment are shown as an attachment to this letter. Please note that these traffic assignments are based upon three crossings of the Black Warrior River, these crossings being the new Hugh Thomas Bridge, U. S. 82 By-Pass Bridge, and a proposed bridge serving the 12th Avenue corridor.

Listed below are traffic projections for the year 2000 along with capacities for the two bridges now in place and the proposed 12th Avenue Bridge.

Mr. Bob Meader
Page 2
August 25, 1975

	Hugh Thomas Bridge	U. S. 82 By-Pass Bridge	12th Avenue Bridge
Assigned Traffic	36,127	26,476	18,565
Capacity (Level of Service "C")	25,000	17,500	17,500

There are 81,168 assigned trips desiring to cross the river and a capacity of 60,000 vehicles per day at a Level of Service "C". This indicates that additional capacity will be needed to adequately serve forecast trip desires.

Questions have arisen concerning the feasibility of actually constructing the 12th Avenue Bridge. As of this date, no actual location studies have been made on this project. We feel that the plan reevaluation may lead to the determination that the 12th Avenue Bridge cannot be built. In this event, there will be a critical need to create additional capacity crossing the river for the year 2000. The proposed highway atop relocated Oliver Dam could help alleviate this deficiency. Special traffic assignments could be run by this office and determination made as to expected traffic which would utilize this proposed highway. It will be necessary to have a proposed location for the new dam in order to perform these assignments.

We trust that the information presented will be helpful to you, and we will be most happy to furnish further explanation or any other information which is necessary.

Yours very truly,

John L. Skinner, Jr.
Chief, Bureau of Urban Planning

JLP/br
Enclosures
cc: Mr. Lewis E. McCray
Mr. B. J. Kemp
File

STATE OF ALABAMA
HIGHWAY DEPARTMENT
MONTGOMERY, ALABAMA 36104

.Y D. BASS
AY DIRECTOR

September 19, 1975

Mr. H. J. Lee, Chief
Navigation and Coastal Branch
Department of the Army
Mobile District, Corps of Engrs.
P. O. Box 2288
Mobile, Alabama 36628

Re: Tuscaloosa Area Transportation Study

Dear Mr. Lee:

This is in response to your letter of August 29, 1975, requesting information concerning potential utilization of a highway bridge atop the relocated Oliver Lock and Dam at Tuscaloosa. Information was furnished to you previously by letter dated August 25, 1975.

A traffic assignment network was developed which provided a corridor in the location of the proposed new Oliver Lock and Dam. Forecast year (2000) traffic was then assigned to this configuration and also to the identical network configuration with the proposed 12th Avenue Bridge deleted. Attached are Exhibits "1", "2" and "3" which depict the results of the traffic assignment process.

Exhibit "1" depicts traffic assignment and roadway capacity for a Level "C" Service assigned to the recommended plan network. This information was furnished to you previously.

Exhibit "2" depicts assigned traffic and capacities with a two-lane highway atop Oliver Lock and Dam. A proposed route for tying this highway segment to the existing network of the highways in Tuscaloosa and Northport is shown by a dashed line. This assignment was made with the proposed 12th Avenue Bridge in place. The number of vehicles desiring to cross Oliver Lock and Dam under this scheme is 7,357.

Exhibit "3" depicts a network identical to the one shown in Exhibit "2" with the exception that the proposed 12th Avenue Bridge has been deleted. Traffic desiring to cross the Oliver Lock and Dam under this scheme is 9,769 vehicles per day.

4005 15th St.
Tuscaloosa, Al.
35401

Mr. H. S. Lee
Chief, Navigation and Coastal Branch
U. S. Army Corps of Engineers
Mobile, Al. 36628

Dear Mr. Lee:

I have marked on the map you sent me, as accurately as I can, two locations of Black Warrior's Town. The rectangle and dot show the location given by Thomas P. Clinton and the circle shows the location given by Dr. W. S. Wyman.

No one knows the exact location of the village. Wyman and Clinton were both considered good historians, Clinton names four people who testified that the village was on both sides of Sanders Ferry Road (Fifteenth Street) Wyman is very explicit in directing one to the site of the town.

I do not know the area covered by this village. Davy Crockett, in his autobiography, says it was a large one. General Coffee, in his report, says that he and his men burned about 50 cabins and a long house.

If the new lock and dam is built near the western edge of the Country Club grounds, land along the river bank is taken for use by the government, and roads are built to the site, it seems to me that the Wyman site might be infringed upon. A good deal would depend on how much land the government wants.

The Clinton site has already been built upon (Snow Terrace). A possible compromise might be made. On Highway 11, abo ut a half mile below my house is an Alabama Historical Association masker which says that half a mile north was located the Creek Indian village of Black Warrior's Town. A smaller marker could be placed between the Clinton and Wyman sites.

Hoping this may help, I am

Very truly yours,

Matt W. Clinton

Matt W. Clinton

Mr. H. J. Lee
Page 2
September 19, 1975

An annual road user cost was computed for the entire street network. The system-wide totals with the year 2000 trips assigned are as follows:

Exhibit "1" network - $159,093,842
Exhibit "2" network - $157,968,355
Exhibit "3" network - $161,380,313

These figures indicate that an annual road user savings of $1,125,487 would be realized if a two-lane highway facility was constructed atop Oliver Lock and Dam in addition to the other facilities in the recommended plan. A benefit-cost analysis could be done using the road user cost figures presented above and estimated construction cost and maintenance cost for the route atop the Dam along with the proposed feeder route.

It should be noted that all traffic assignments were made utilizing land use projections developed by the West Alabama Planning and Development Council. At the time this data was developed, no consideration was given to an additional crossing of the Black Warrior River in the vicinity of the proposed Oliver Dam. If this corridor were opened, then significant changes may occur in land use and development patterns on both sides of the river. These changed land use and development patterns could very well increase the number of vehicles desiring to cross the Dam. However, present land use projections indicate a two-lane facility would adequately handle traffic desires.

If additional information or explanation is needed, please feel free to contact this office.

Yours very truly,

John L. Skinner, Jr.
Chief, Bureau of Urban Planning

JLSjr/JLP/br
Attachments
cc: Mr. B. J. Kemp w/attachs.
Mr. Lewis McCray w/attachs.
File

Matthew W. Clinton, Tuscaloosa, Ala.: Its Early Days, P. 8.

About the location of Black Warrior's Town Dr. W. S. Wyman says, "If any reader of this true story wishes to visit the site of the old town, let him walk down Eighth Street, Tuscaloosa, toward the west. At or near the west end of this street he will find a wagon gate owned by Mr. E. N. C. Snow. Passing through this gate, if he will turn to the right, and walk northwardly toward the river, he will soon find himself on the spot where the old town stood." This description places Black Warrior's Town on the Snow place just west of the Country Club grounds. Dr. William Stokes Wyman married Melássa, daughter of Alexander Dearing, whose brother, James H. Dearing, came to Tuscaloosa in the very first year of its existence as a town inhabited by white people. That was in 1816. Dr. Wyman learned much about the early days of Tuscaloosa from these and other early settlers.

Thomas P. Clinton located the town on the north side of Sander's Ferry Road about a hundred yards west of the intersection of Sander's Ferry and Old Highway 11 branching off Eighth Street. He stated that the town was on the north side of the road and that the fort stood on the south side. The fort was called Seminole Fort. In the Creek language " Seminole" means "Separatists." Since the Creek ~~extended~~ territory extended into Georgia and their chief settlements were on the Alabama River and its branches, the Creeks on the Warrior were truly separatists. Thomas Clinton owned the l land where he said the fort was located, and he stated that when he had the field subsoiled, several large Indian cooking vessels and other artifacts were plowed up.

The location of the fort was also verified by Martin Sims, who came here in 1818 and who was for many years the bridgekeeper at Tuscaloosa, and by Charles Whitfield, an old Negro, who told Thomas Clinton that he remembered the remnants of the old fort, Judge Washington Moody also stated used to pass the site of the old fort every day on his way to school The Moody's, at that

lived west of Tuscaloosa on the Sander's Ferry Road. Sims stated that the Indian town was on Sander(s Ferry Road one and one half mileswest of Tuscaloosa on the Inge place, afterward known as the O'Connor place. Still later this property was owned by E. N. C. Snow. A descendant of William Wilson, who settled in Tuscaloosa in 1816, said that William Wilson had lived on the Inge place and related that the fort had stood across the road from his house.

Actually , there is not a great deal of difference in the ~~st~~ sites specified by Dr. Wyman and Thomas Clinton.. The two sites are within three hundred yards of each other. The village could have extended from one site to the other since it is described as a large one. There is a spring almost midway between the locations, and we may de sure that the Indians lived near that spring.

The Tuscaloosa County Historical Preservation Authority

■ POST OFFICE BOX 1776
TUSCALOOSA, ALABAMA 35401

October 20, 1975

Mr. Glendon L. Coffee
Biologist, Environmental Studios Section
U. S. Army Engineer District
Mobile Corps of Engineers
P. O. Box 2288
Mobile , AL 36629

Re: Proposed Oliver Lock and Dam Replacement on Black Warrior River

Dear Mr. Coffee:

I would like to thank you for making the trip to Tuscaloosa To investigate the proposed site #2 for the Oliver Lock and Dam replacement on the Black Warrior River. As you know the Tuscaloosa County Historical Preservation Authority and the Alabama Historical Commision are very concerned about the possible location of a new dam at this site since it might interfer with the location of Black Warrior's Town, a site which we are hoping to get listed on the National Register and develop into an historical site.

After your meeting with Gregg Free and Dr. Summersell, I am sure you understand and appreciate the historical significance of Black Warrior's Town for the County and City of Tuscaloosa and the State of Alabama. I am enclosing material from Matthew P. Clinton's book, Tuscaloosa, Alabama, Its EArly Days 1816 - 1865, and Thomas C. McCorvey's book Introduction to the History of Tuscaloosa, Alabama, which will provide you with further data on the history of the Indian Town and its relationship and importance to the present.

I understand from Gregg that during your exploration of the site, you came upon the spring that is mentioned on page 9 of Clinton's book. This will be most meaningful in our archeological work in pinpointing the perimeters of the town.

If you have any questions or would like additional information about this subject, please contact me.

Sincerely,

Christie R. Rudnick

Christie R. Rudnick

DEDICATED TO THE PRESERVATION AND DEVELOPEMENT OF OUR HERITAGE

CHARLES J. TURNER SR. GENERAL MANAGER

SIXTH STREET PHONE 758 752
TUSCALOOSA, ALABAMA 35401

August 4, 1976

District Engineer - Mobile District
Corps of Engineers
P. O. Box 2288
Mobile, Alabama 36628

Dear Sir:

It is respectfully requested that this Club be informed of all current plans for replacement of the William Bacon Oliver Lock & Dam.

We are presently in the process of making long range plans for the Country Club, and more specifically, the golf course. It would be most beneficial to us in our planning if we could be informed as to any specific and/or detailed plans you may be anticipating in the replacement of the lock & dam.

For the above reason and as adjacent property owners, we are sure that you can appreciate our concern in this matter. Your immediate reply is requested.

FOR THE BOARD OF GOVERNORS
COUNTRY CLUB OF TUSCALOOSA

Harry H. Ferguson, Jr.

Harry H. Ferguson, Jr.
General Manager

HHF/pj

Met Sep 30 - LTC Pope & I met to discuss Oliver Rehab vs Replacement. Advised that they would be kept informed as study progresses. They are interested in land swap if possible.
HC

STATE OF ALABAMA
ALABAMA HISTORICAL COMMISSION
725 MONROE STREET
MONTGOMERY, ALABAMA 36104

WARNER FLOYD
EXECUTIVE DIRECTOR

TELEPHONE NUMBER
832-6621

December 3, 1976

Mr. Lawrence R. Green
Chief, Planning Division
U. S. Corps of Engineers
P. O. Box 2288
Mobile, Alabama 36628

Re: SAMPD-ES
Oliver Lock and Dam Project
Tuscaloosa

Dear Mr. Green:

As stated in our letter to the Corps dated May 26, 1975, alternative site # 2 for replacement of the William Bacon Oliver Lock and Dam will possibly have adverse affects on historic Black Warrior's Town. In accordance with Public Laws 89-665, 91-190, 93-291 and Executive Order 11593, the Alabama Historical Commission, the state office of historic preservation, recommends an assessment of the area be conducted by a professionally-trained archaeologist to determine the exact location of the Black Warrior's Town Site.

A copy of the archaeologist's report should be submitted to this office for our review and comments prior to any surface disturbance activities.

Sincerely,

W. Warner Floyd

W. Warner Floyd

GCB

PARKER TOWING COMPANY, INC.
P. O. BOX 72 • TUSCALOOSA, ALABAMA 35402 • 205-349-1677

January 4, 1980

Col. Robert H. Ryan
District Engineer
United States Army Corps of Engineers
P. O. Box 2288
Mobile, Alabama 36628

Dear Col. Ryan:

It is my understanding that the Oliver Lock replacement study will not be completed until 1982. The purpose of this letter is to express my concern that the existing structure will become a serious navigational bottleneck in the not too distant future.

Traffic delays at Oliver Lock are increasing. During the month of November, 1979, our boats averaged in excess of thirty (30) minutes delay per locking. This does not include delays resulting from "double" lockings that would be single lockings at a 600' x 110' lock, nor does it include the likelihood of increased mechanical breakdowns at Oliver Lock due to its age. Delays of two (2) to four (4) hours are not uncommon. Please consider the following:

1. The outlook for coal to move through Oliver Lock in the 1980's is almost unanimously bullish for a sharp increase.

2. In these energy conscious times fuel is being wasted by boats waiting their turn to lock.

3. Coal constitutes the largest single commodity moving on the Black Warrior-Tombigbee River System. The major recipients of that coal are utilities located in Alabama, Florida and Mississippi. Inefficiencies in the transportation system will result in higher costs that will be passed along to electrical consumers.

I don't think anyone will disagree with the fact that Bankhead Lock and Dam was replaced at least one (1) or two (2) years too late. Considering the normal lead time for funding Corps projects and the possibility of environmental and railroad opposition, I

urge you to consider speeding up the Oliver Lock replacement study (and related points, such as locking water) or break this study out as a separate project. If the Black Warrior-Tombigbee River System is to continue to be a viable transportation system in the years ahead, we need to be making plans today to replace Oliver Lock with a modern 600' x 110' structure.

I am taking the liberty of sending copies of this letter to other operators and would ask that they advise you of their own experience at Oliver Lock. I will be glad to pursue this subject in further detail with your staff.

Sincerely,

Tim Parker, Jr.

Tim Parker, Jr.

TPJ/i

CC: Mr. Nick Barchie, Jr., Warrior and Gulf
Mr. Tom Findlay - Findlay Towing Company
Mr. Norman S. Ivey - American Commercial Barge Lines
Mr. Shelton Morgan - Black Warrior-Tombigbee Development Association

PARKER TOWING COMPANY, INC.
P. O. BOX 72 • TUSCALOOSA, ALABAMA 35402 • 205-349-1677

October 23, 1980

Mr. Roger Burke
U. S. Army Corps of Engineers
P. O. Box 2288
Mobile, Alabama 36628

RE: Traffic Delays at Oliver Lock

Dear Roger:

As you probably know by now, there has been a dramatic increase recently in lock delays at Oliver Lock. Eight (8) to twelve (12) hour delays are becoming common place. These delays are a result of significant increases in six (6) barge tows transiting the Lock.

I estimate that there are now at least thirty (30) towboats operating on the BWT that are now routinely handling six (6) barge tows. That same number sixty (60) days ago was probably ten (10) boats. Each of those boats will normally average four (4) to five (5) round trips per month on the BWT System or eight (8) to ten (10) trips per month each through Oliver Lock.

We woefully miscalculated the replacement date of the Old Bankhead Lock and I would hope that we don't make the same mistake again.

I am sure you are taking into consideration these new delays and the new coal traffic moving on the BWT. I would like to urge that the replacement study for Oliver Lock be expedited and if necessary put on an emergency basis.

Sincerely,

Tim

Tim Parker, Jr.

TPJ/i

CC: Colonel Robert H. Ryan
Mr. Sheldon Morgan
Mr. Clarence Kilian/Offa Nichols

PARKER TOWING COMPANY, INC.
P. O. BOX 72 • TUSCALOOSA, ALABAMA 35402 • 205-349-1677

December 3, 1980

Mr. W. F. Pruett, Chief
Project Operation Branch
U. S. Corps of Engineers
P. O. Box 2288
Mobile, Alabama 36628

Dear Forrest:

In regards to the seven [7] items recently identified as non-structural measures that could help the situation at Oliver Lock, we have the following comments:

A. Lockage of Three [3] Simultaneous Tows in One [1] Direction Before Changing Direction.

Specifically how will this help?

B. Installation of a Modern Tow Haulage Unit.

Assuming a good high speed efficient unit, I think this is an excellent idea.

C. Use of Extra Boats Upstream or Downstream of Lock to Assist in Lockage.

Given the current state of delays I don't see any reason for this at this time. I would also raise the question as to whose responsibility it is to pay for use of these shiftboats; the Corps or industry?

D. Allowing Only Tows Ready to be Served to be Logged for Service.

I would object strenously to this rule as it is written. It is absolutely ludicrous to have boats that may have to wait for four [4] to fourteen [14] hours not to be able to do other useful tasks during that time as long as they are ready to lock when their time comes. Any boat not ready to lock when their turn comes up, should be put to the end of the line. As an example, immediately

below Oliver Lock, the Hunt Oil facility is a frequent fueling spot for many boats. There is no logical reason in the world why boats facing an extended locking delay should not be able to break out of their tow and take on fuel at the Hunt Oil lock. Should a boat in that situation not be ready to lock when their turn comes, they should go to the end of the line, but there is no reason to penalize an operator for making the most efficient use he can of locking delay time.

E. Additional Mooring Facilities.

This should help, but we would have to see specifically how many and where they are located.

F. Extension of Guide Wall.

On the assumption that this did not require any additional lock closure time, this could be an excellent idea.

G. Extension of Tow Haulage Reach Beyond Guide Wall.

Sounds good, but we would need additional details and also know how effective this would be in high water.

Sincerely,

Tim

Tim Parker, Jr.

TPJ/i

CC: Mr. Daniel W. Beasley
Mr. Ed Varner

FEDERAL ENERGY REGULATORY COMMISSION

REGIONAL OFFICE

730 Peachtree Street, N. E.
Atlanta, Georgia 30308
May 7, 1981

District Engineer
Corps of Engineers
Department of the Army
P. O. Box 2288
Mobile, Alabama 36628

Dear Sir:

This is in response to a letter from Mr. Mason B. Oldham, Jr., of April 16, 1981, your file SAMPD-C, requesting certain information and data for use in formulation and evaluation of alternative plans of the Black Warrior-Tombigbee Rivers, such as generalized power values for privately and Federally financed alternatives using fuel cost escalation in accordance with Section 713.615(a)(1) of the Water Resources Council's "Procedures for Evaluation of the National Economic Development Benefits and Cost in Water Resources Planning (Level C)," and other additional information which is now the responsibility of the Economic Regulatory Administration.

The latest generalized power values we have available are based on July 1979 price level (a copy was transmitted to your Mr. William F. Hearrean, Chief Socio-Economics Branch, by our letter dated August 15, 1980). These values have not been updated due to staffing problems and any work on updating them is done as time permits. It will take approximately five man-weeks to update using January 1980 price levels. Our schedule at this time does not permit us to have someone work full time on power values; however, we will do all we can to expedite your request.

Your request for additional information, listed in your letter as a., b., d., and e., should be submitted to:

Mr. William E. Scott
Economic Regulatory Administration
Power Supply and Reliability
1655 Peachtree Street, N. E.
Atlanta, Georgia 30367

If you could provide us with the specific plant factors of the hydro projects which are planned we could provide you the site specific power values sooner than we can the generalized values.

Very truly yours,

Aarne O. Kauranen
Regional Engineer

SOUTHEASTERN ELECTRIC RELIABILITY COUNCIL

R. L. Addison
Chairman
President
Gulf Power Company
P. O. Box 1151
Pensacola, Florida 32520

E. A. "Al" Adomat
Vice Chairman
Executive Vice President
Florida Power & Light Company
P. O. Box 529100
Miami, Florida 33152

Wm. R. Brownlee
Administrative Manager
308 Daniel Building
15 South 20th Street
Birmingham, Alabama 35233
Phone (205) 252-0069

June 11, 1981

Mr. Lawrence R. Green
Chief, Planning Division
Mobile District, Corps of Engineers
Post Office Box 2288
Mobile, Alabama 36628

Dear Mr. Green:

We wish to thank you for your letter of May 28 outlining plans for certain studies to address the feasibility of adding hydroelectric power generating facilities at three existing Corp of Engineers' locks and dams. In response to your request, we loaned you a copy of SERC's report, *Coordinated Bulk Power Supply Program*, on June 2.

Response to the other request for information required our clarifying telephone conversation of June 9.

Referring to item (a), the loaned report provides a rather complete description of the Southern subregion including projected loads, capacities, reserves and future transmission lines. Line locations are shown on the Southern subregional map.

Under item (b), a great deal of study has been devoted to subjects such as load management, and many study results have been inconclusive, making this facter somewhat speculative. However, the systems of the Southern Company have included the effect of load management in determining the peak and energy forecast given for different years.

We believe item (c) can best be answered by the attached copy of pages 26 and 27 of Southern's report under FPC Form No. 12 for the calendar year 1980. These include our loads for the week containing the maximum load for the month of April 1980, the week containing the maximum load for the month of August 1980, and the week containing the maximum load for December 1980. Graphs of these numbers are not being prepared at this time, and there is no reason to predict any meaningful change in the shape of these three typical weekly loads for future years such as 1985 and 1990.

We hope that this information, together with our report, will supply the data needed for your study. However, if you have any further questions, we will try to provide answers.

Sincerely,

Wm. R Brownlee

Wm. R. Brownlee

WRB:kb

Attachment

FEDERAL ENERGY REGULATORY COMMISSION

REGIONAL OFFICE
730 Peachtree Street, N.E.
Atlanta, Georgia 30308
June 29, 1981

District Engineer
Corps of Engineers
Department of the Army
Post Office Box 2288
Mobile, Alabama 36628

Dear Sir:

This is to supplement our letter of May 7, 1981, which responded to an April 16, 1981, letter from Mr. Mason B. Oldham, Jr., your file SAMPD-C. As a result of Messrs. Foreman (S.A.D.) and Burke (Mobile) May 21, 1981, visit to our office, at which time they agreed that we need only supply the values of a 15-percent hydro capacity factor for combustion turbine units and 50 percent for coal-fired units rather than supply the full range of alternatives, we were able to cut down on the timetable indicated in our May 7, 1981, letter. The values are based on January 1980 interest rates for Federal financing of 7-1/8 percent and private financing of 11-1/2 percent.

Our estimates of the value of power from hydroelectric projects are based on the cost of producing power at modern alternative electric generating plants, using the methodology described in "Hydroelectric Power Evaluation," DOE/FERC-0031, dated August 1979. The total value is composed of a "capacity component" which corresponds to the fixed capital charges and fixed operating costs of the alternative electric plant and transmission facilities, and an "energy component" which corresponds to the other operating expenses which are variable in nature and generally dependent upon the number of kilowatt-hours generated.

The present procedure is to develop values assuming a 7-1/2 percent plant factor for combustion turbine units, and 55 percent for coal-fired units. These plant factors are assumed to be the equivalent average lifetime plant factor of the unit type in question. In order for the alternatives to be comparable, certain adjustments are applied. One is to compensate for the difference in plant factor of the alternatives and the proposed hydro project; another is for the difference in energy costs of the alternative and the system energy costs of the plants which the alternative would displace; and a third adjustment is made to take into consideration the rapid response to load changes provided by hydroelectric projects. In some cases, these adjustments can have a significant influence on the power value of a hydro project.

Two alternatives were computed for the Oliver Lock and Dam. First, with a 15-percent capacity factor, would be a combustion turbine generating plant. The capital installed cost as of January 1980 of providing combustion turbine capacity in Power Supply Area 22, the area in which the Oliver Lock and Dam is located, amounts to about $205 per kilowatt for private and $195 per kilowatt for Federal financing, including the step-up substation. This is based on two 75,000-kilowatt units burning oil. The cost of oil as of January 1980 was 559.0 cents per million Btu. Second, with a 50 percent capacity factor, would be a coal-fired steam-generating plant. The capital installed cost as of January 1980 of providing coal-fired capacity in the same area amounts to about $807 per kilowatt for private and $715 per kilowatt for Federal financing, including the step-up substation and SO_2 removal. This is based on two 800,000-kilowatt units. The cost of coal as of January 1980 was 160.0 cents per million Btu.

Energy values given are based on current fuel cost levels escalated for real fuel price increases. Escalated real fuel costs assume a 1985 project-on-line date and various percentages cost of money to levelize them over the 100-year life of the hydroelectric plant. The escalation rates beyond 30 years were assumed to continue at the same rate as that at the end of 30 years. Real fuel cost escalation factors were taken from Department of Energy data published January 23, 1980, in the Federal Register Part IX.

The estimated fixed charge with Federally-financed value of 7-1/8 percent is 8.17 percent, and private financing of 11-1/2 percent is 15.74 percent. Using the fixed charge rates and other alternative costs, we estimate the values of power to be as follows:

Type of Financing	Capacity ($/kW/yr)	Energy (Mills/kWh)	Equivalent Total Power Value 1/ ($/kW/yr)	(Mills/kWh)
		Combustion Turbine Alternative		
		(15 percent hydro capacity)		
Federal	4.35	107.00	144.95	110.30
Private	23.35	99.20	153.70	116.95

Coal-Fired Alternative

(50 percent hydro capacity)

Federal	79.20	21.80	174.70	39.90
Private	155.80	20.85	247.10	56.40

1/ Example: Component power values of $23.35/kW/yr and 99.20 mills/kWh at 15 percent hydro capacity (private financing) are equivalent to a total annual value of either $153.70/kW/yr or 116.95 mills/kWh (but not both).

The estimates of power values for the Oliver Lock and Dam, based on the cost of a Federally-financed alternative plant, are furnished per your request.

Very truly yours,

Aarne O. Kauranen
Regional Engineer

cc: SEPA

cc: Div. Engr. Atlanta, Ga.

FEDERAL ENERGY REGULATORY COMMISSION

REGIONAL OFFICE

730 Peachtree Street, N. E.
Atlanta, Georgia 30308
September 28, 1981

District Engineer
Corps of Engineers
Department of the Army
P. O. Box 2288
Mobile, Alabama 36628

Dear Sir:

This is in response to a letter dated August 20, 1981, from Mr. William Reid, your file SAMPD-C, requesting additional information and data for use in the formulation and evaluation of possible hydropower at Oliver Lock on the Black Warrior River in Tuscaloosa for plant factors of 30 percent and 35 percent. The values are based on January 1980 interest rates for Federal financing of 7-1/8 percent and private financing of 11-1/2 percent.

Our estimates of the value of power from hydroelectric projects are based on the cost of producing power at modern alternative electric generating plants, using the methodology described in "Hydroelectric Power Evaluation," DOE/FERC-0031, dated August 1979. The total value is composed of a "capacity cost" of the alternative electric plant and transmission facilities, and an "energy component" which corresponds to the other operating expenses which are variable in nature and generally dependent upon the number of kilowatt-hours generated.

The present procedure is to develop values assuming a 7-1/2 percent plant factor for combustion turbine units, 25 percent for combined cycle units, 55 percent for coal-fired units, and 65 percent for nuclear units. These plant factors are assumed to be the equivalent average lifetime plant factor of the unit type in question. In order for the alternatives to be comparable, certain adjustments are applied. One is to compensate for the difference in plant factor of the alternatives and the proposed hydro project; another is for the difference in energy costs of the alternative and the system energy costs of the plants which the alternatives would displace; and a third adjustment is made to take into consideration the rapid response to load changes provided by hydroelectric projects. In some cases, these adjustments can have a significant influence on the power value of a hydro project.

Two alternatives were computed. First, with a 30-percent capacity factor, would be a combined cycle generating plant. The capital installed cost as of January 1980 of providing combined cycle capacity in Power Supply Area 22 amounts to about $377 per kilowatt for private and $360 per kilowatt for Federal financing, including the step-up substation. This is based on two 400,000-kilowatt units burning oil. The cost of oil as of January 1980 was 559.0 cents per million Btu. Second, with a 35-percent capacity factor, would be a coal-fired steam-generating plant. The capital installed cost as of January 1980 of providing coal-fired capacity in the same area amounts to about $807 per kilowatt for private and $715 per kilowatt for Federal financing, including the step-up substation and SO_2 removal. This is based on two 800,000-kilowatt units. The cost of coal as of January 1980 was 160.0 cents per million Btu.

Energy values given are based on current fuel cost levels escalated for real fuel price increases. Escalated real fuel costs assume a 1985 project-on-line date and various percentages cost of money to levelize them over the 100-year life of the hydroelectric plant. The escalation rates beyond 30 years were assumed to continue at the same rate as that at the end of 30 years. Real fuel cost escalation factors were taken from Department of Energy data published January 23, 1980, in the Federal Register Part IX.

The estimated fixed charge with Federally-financed value of 7-1/8 percent is 8.17 percent, and private financing of 11-1/2 percent is 15.74 percent. Using the fixed charge rates and other alternative costs, we estimate the values of power, which have been rounded off to the nearest whole number, to be as follows:

Type of Financing	Capacity ($/kW/yr)	Energy (Mills kWh)	Equivalent Total Power Value 1/ ($/kW/yr)	(Mills/kWh)
		Combined Cycle Alternative		
		(30 percent hydro capacity)		
Federal	27.00	75.00	224.00	85.00
Private	60.00	69.00	243.00	92.00
		Coal-Fired Alternative		
		(35 percent hydro capacity)		
Federal	79.00	22.00	145.00	48.00
Private	156.00	21.00	220.00	72.00

1/ Example: Component power values of $60.00/kW/yr and 69.00 mills/kWh at 30 percent hydro capacity (private financing) are equivalent to a total annual value of either $243/kW/yr or 92.00 mills/kWh (but not both).

The estimates of power values for the Oliver Lock and Dam, based on the cost of the Federally-financed alternative plant, are furnished per your request.

Very truly yours,

Aarne O. Kauranen
Regional Engineer

cc: SEPA

cc: Div. Engr.
Atlanta

STATE OF ALABAMA
GOVERNOR'S OFFICE
MONTGOMERY 36130

FOB JAMES
GOVERNOR

August 6, 1982

Colonel Robert H. Ryan
District Engineer
Mobile District
Army Corps of Engineers
Post Office Box 2288
Mobile, Alabama 36628

Dear Colonel Ryan:

Thank you for your letter of July 6, 1982, concerning the study of the William Bacon Oliver Lock and Dam which raised several interesting points. I was pleased to hear the study, when released in September 1983, will recommend a new larger lock for this bottleneck on the Warrior River. With the large amount of traffic this waterway is receiving, especially coal movements, it is important to the State and the nation that we continue to utilize our resources in a responsible manner.

I was most interested to hear for the first time of the real possibility for a hydroelectric facility which may be co-located with the navigation structure. However, this raises many questions, too numerous to discuss here, such as ownership of the hydroelectric facility if additional cost sharing were implemented by Congress, to whom and how the electricity would be sold, and, after the repayment of the cost of contruction by the sale of electricity, to whom would the additional revenues accrue, if any, etc.

Many of the points you raise are based on proposal, some of which to my knowledge have not been submitted to Congress or have become rules for water resource projects. In the case of the Oliver Lock and Dam replacement, it is my understanding that it has not been determined if a non-federal sponsor is needed, and, if so, who might be the appropriate entity. Since the requirement for a non-federal sponsor would only be needed for the addition of hydroelectric generation, the sponsor could be any of several entities either existing or new.

AD-A138 450 INTERIM FEASIBILITY REPORT AND ENVIRONMENTAL IMPACT STATEMENT FOR OLIVER..(U) CORPS OF ENGINEERS MOBILE AL MOBILE DISTRICT DEC 83 COESAM/PDW-83/001 6/6

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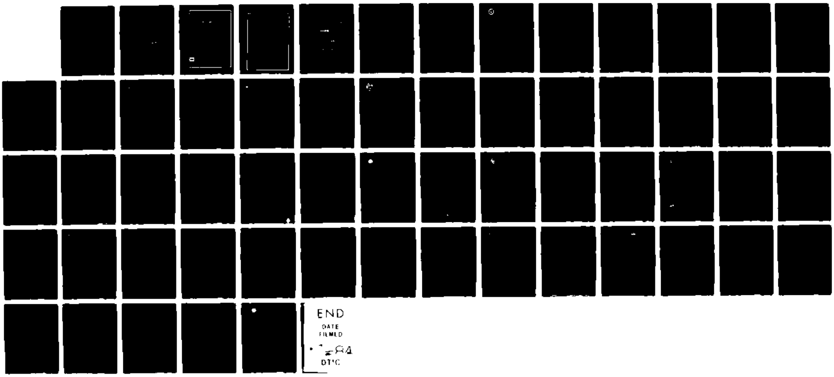

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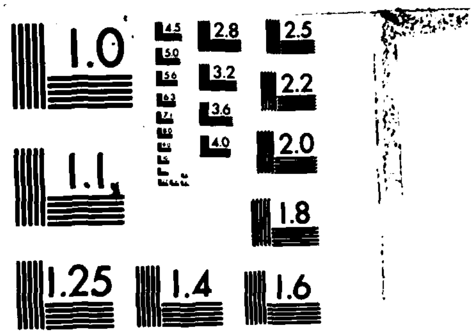


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Colonel Robert H. [illegible]an
Page 2
August 6, 1982

In closing, I support the completion of the Oliver study and look forward to early action to insure removal of this bottleneck. In reference to your interest in my views to participate financially, I do not believe we have been requested to be the non-federal sponsor for the hydroelectric facility at this time. Therefore, no additional commitment is needed. Since we have not reviewed or received the unreleased study, I feel it would be premature and ill-advised to provide a binding commitment with so many unresolved issues. Further, we do not currently have in place any method which would allow a commitment on my part, although this is an interesting idea and certainly warrants additional discussion.

As past actions have indicated, the State of Alabama has always been willing to meet the requirements as defined by statutes and we do not anticipate any foreseeable Congressional action which would change our commitments for supporting water resource projects.

We look forward to discussing these issues as the Oliver study moves forward.

Sincerely,

FJ/jt

ANNOUNCEMENT OF

PUBLIC MEETING

FOR

REPLACEMENT OF

WILLIAM BACON OLIVER LOCK

BLACK WARRIOR-TOMBIGBEE RIVERS, ALABAMA

THE MEETING WILL BE HELD AT

The Stagecoach Inn (see map)
I-59 and Skyline Boulevard
Tuscaloosa, Alabama
Tuesday Night
12 April 1983
7:00 p.m.

US Army Corps
of Engineers
Mobile District

THIS IS YOUR INVITATION!

The Mobile District of the US Army Corps of Engineers is nearing completion of its study of the *William Bacon Oliver Lock and Dam* on the Black Warrior River. The study is part of the continuing review of the Black Warrior-Tombigbee River system authorized by the Congress in 1950.

Studies show that it is feasible to replace 40-year old Oliver Lock at this time. We have examined three alternative sites for the Lock and the possibility of adding a small hydroelectric power generating plant. Presentations at the meeting will define each alternative and its attributes. We hope you will find our evaluations to be complete and encourage you to attend the meeting to discuss the plans with us.

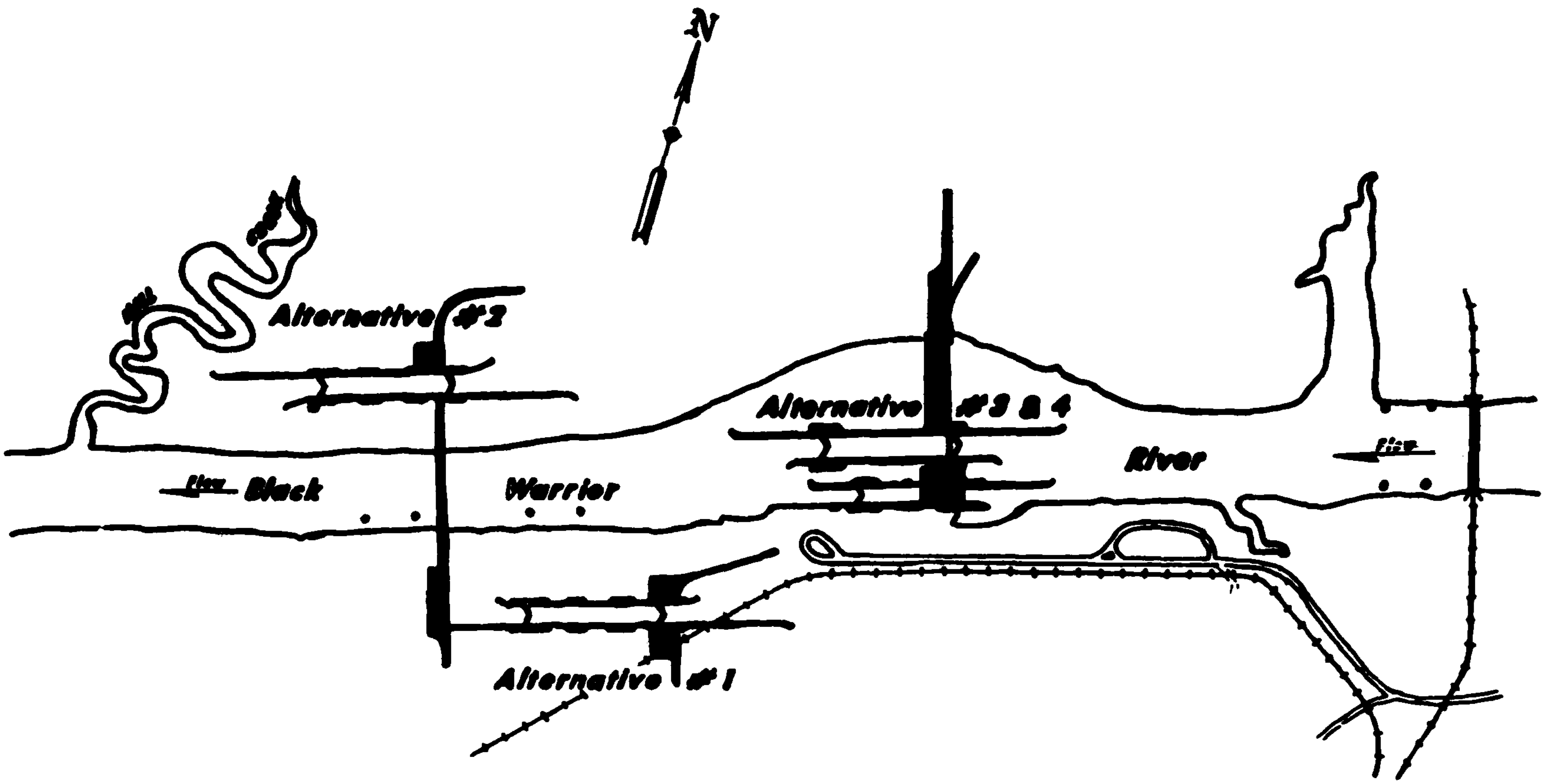
Everyone is invited and urged to be present or represented, and you will be given an opportunity to express your views. Oral statements will be heard, but for accuracy of the record, all important facts and comments should be submitted in writing. Written statements may be turned in at the meeting or mailed to me by May 13, 1983. All statements, both oral and written, will become part of the official record of this study and will be made available for public examination unless you specify you want your statement to remain confidential.

Please bring this announcement to the attention of persons you know to be interested in the *Oliver Lock and Dam.*

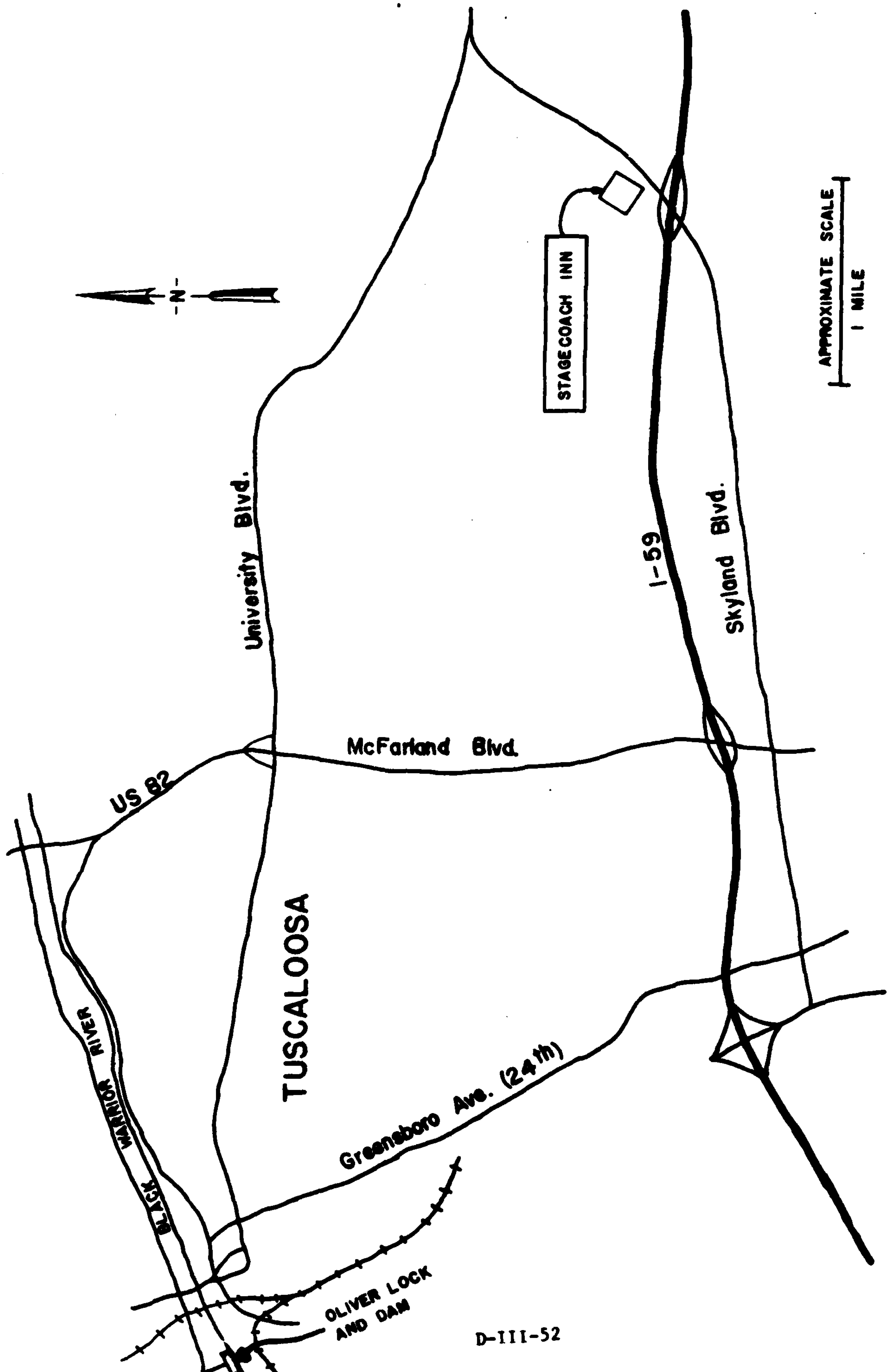
Sincerely,

Patrick J. Kelly

PATRICK J. KELLY
Colonel, CE
District Engineer



ALTERNATIVES FOR REPLACEMENT OF WM. BACON OLIVER L & D


N
STAGECOACH INN
APPROXIMATE SCALE
1 MILE
University Blvd.
I-59
Skyland Blvd.
McFarland Blvd.
US 82
TUSCALOOSA
BLACK WARRIOR RIVER
Greensboro Ave. (24th)
OLIVER LOCK AND DAM

APPENDIX D

SECTION IV

Coordination Mailing List for Draft Report

DEPARTMENT OF THE ARMY
MOBILE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2288
MOBILE, ALABAMA 36628

March 17, 1983

REPLY TO
ATTENTION OF:
Western Basins Branch

Enclosed is a copy of the Draft Interim Feasibility Report and Draft Environmental Impact Statement (DEIS) on the Oliver Lock Replacement, Black Warrior-Tombigbee Rivers, Tuscaloosa, Alabama. Copies of this report are being furnished to local, State, and Federal agencies and other interested parties for their review and comments. Please provide any comments you may have to this office, Attention: Western Basins Branch, by May 9, 1983. If you would like further information on either the draft report or the DEIS, please contact Mr. Bob Meader or Ms. Carol Gorbics at (205) 694-3836/690-2726 or FTS 537-3836/2726, respectively.

Also, I call your attention to a public meeting which has been scheduled to discuss this report's conclusions. The meeting will be held on April 12, 1983 at 7 p.m. at the Stagecoach Inn (I-59 and Skyland Boulevard) in Tuscaloosa.

Sincerely,

Lawrence R. Green

Lawrence R. Green
Chief, Planning Division

Enclosure

DRAFT
INTERIM FEASIBILITY REPORT
FOR
OLIVER LOCK REPLACEMENT COORDINATION MAILING LIST

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Federal Energy Regulatory Commission
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Mr. Joseph Binder
Rual Electrification Admin.
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Washington, D. C. 20250

Mr. Robert Stern
Division of NEPA Affairs
Department of Energy
Room 4G064
1000 Independence Ave., SW
Washington, D. C. 20585

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Development & Budget
ATTN: Dir., Off. of Environ Proj. Review
Department of the Interior
Washington, D. C. 20240

Acting Director
Environmental Affairs Office
Room 3425, Department of Commerce
14th & E Streets, NW
Washington, D. C. 20230

Reg Dir., Nat'l Oceanic & Atmos Admin
Nat'l Marine Fisheries Service
SE Regional Office, Region 2
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St. Petersburg, FL 33702

National Marine Fisheries Service
Environmental Assessment Branch
3500 Delwood Beach Rd
Panama City, FL 32401

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Department of HUD
Richard B. Russell Federal Building
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Atlanta, GA 30303

Assistant Regional Adm. for CPD
ATTN: Environmental Standards Officer
Department of HUD, Region IV
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Birmingham Area Office DHUD
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Suite 515, 1720 Peachtree Rd. NW
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8th Coast Guard Disteict
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Administration, Southern Region
ATTN: Chief, Planning &
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DRAFT
INTERIM FEASIBILITY REPORT
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Food & Drug Administration
60 Eitht Street, NW
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Gulf Coast Technical Service Unit
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PO Box 158
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State Conservationist
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Southeast Regional Office
Heritage Conservation & Recreation Ser
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Office of State Planning and
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3734 Atlanta Highway
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Director
Marine Resources Division
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Post Office Box 188
Dauphin Island, AL 36258

Honorable Charles Graddick
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State of Alabama
Montgomery, AL 36104

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Water Resources Activity
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Vector Biology and Control Division
Bureau of Tropical Diseases
Center for Disease Control
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Fish and Wildlife Service
Division of Ecological Services
NSTL Station, MS 39529

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Tuscaloosa Office
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DRAFT
INTERIM FEASIBILITY REPORT
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OLIVER LOCK REPLACEMENT COORDINATION MAILING LIST

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DRAFT
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Mrs. T. R. Horne
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Hydraulics Laboratory
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DRAFT
INTERIM FEASIBILITY REPORT
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Metairei, LA 70001

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Reg. Dir., SE Regional Office
National Wildlife Federation
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Birmingham, AL 35209

Alabama Water Improvement Commission
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Mobile, AL 36609

Ms. Joan Angermann
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Culiman, AL 35055

Mr. Jerry Austell
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DRAFT
INTERIM FEASIBILITY REPORT
FOR
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Representative, Birmingham Audubon Soc.
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Birmingham, AL 35213

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Atlanta, GA 30342

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School of Agriculture & Ag
Experiment Station System
Auburn, AL 36830

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David Smith & Associates
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San Diego, CA 92109

Mr. Tom Bourland
Wildlife Specialist
International Paper Company
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Mr. Thomas A. Brindley
901 Tannahill Drive
Huntsville, AL 35302

Mr. Milton Brown
Post Office Box 8011
Mobile, AL 36608

Department of Energy
Southeastern Power Administration
Elberton, GA 30635

APPENDIX D

SECTION V

Comments and Responses on 1983 Draft Interim Report

U.S. Department
of Transportation
Federal Aviation
Administration

Southern Region

P. O. Box 20636
Atlanta, Georgia 30320

APR 7 1983

Mr. Lawrence R. Green
Chief, Planning Division
Department of the Army
Mobile Corps of Engineers
P. O. Box 2288
Mobile, Alabama 36628

Dear Mr. Green:

Draft Interim Feasibility Report and Draft Environmental Impact Statement on the Oliver Lock Replacement, Black Warrior-Tombigbee Rivers, Tuscaloosa, Alabama

This will acknowledge your letter of March 17, 1983, advising that the Corps of Engineers has prepared the subject report.

We have reviewed the project with respect to potential environmental impact for which this agency has expertise. Our review indicates there will be no significant adverse effects to the existing or planned air transportation system as a result of this project.

Thank you for the opportunity to review and comment on this proposal.

Sincerely,

Robert T. Francis II
Manager, Program Evaluation and
International Staff, ASO-4

RESPONSE TO FEDERAL AVIATION ADMINISTRATION:

Comments are acknowledged, no response is necessary.

U.S. Department
of Transportation
Federal Highway
Administration

Alabama Division Office

441 High Street
Montgomery, Alabama 36104

April 8, 1983

IN REPLY REFER TO:

HEC-AL

Mr. Lawrence R. Green, Chief
Planning Division
Department of the Army
Mobile District, Corps of Engineers
P. O. Box 2288
Mobile, Alabama 36628

Attention: Western Basins Branch

Dear Mr. Green:

Subject: Draft Interim Feasibility Report
and Draft Environmental Impact Statement
(DEIS) on the Oliver Lock Replacement,
Black Warrior-Tombigbee Rivers,
Tuscaloosa, Alabama

Your letter of March 17, 1983, transmitted the subject report and DEIS for our review and comments.

We have reviewed these documents to determine if the proposed action would affect planned or existing highways within the project corridor area. We have concluded the proposed action would not impact the highway system in the project corridor area.

Sincerely yours,

L. N. MacDonald
Division Administrator

RESPONSE TO FEDERAL HIGHWAY ADMINISTRATION:

Comments are acknowledged, no response is necessary.

ENVIRONMENTAL DEFENSE FUND

April 18, 1983

U.S. Army Corps of Engineers
Mobile District
109 St. Joseph Street
P.O. Box 2280
Mobile, Alabama 36628

Re: <u>Oliver Lock</u>

Gentlemen:

You kindly have sent me a copy of the Draft Interim Feasibility Report and EIS for Oliver Lock Replacement. Appendix B "Economics" is missing, except for the Table of Contents. Please send us the complete Appendix B.

Yours very truly,

James T. B. Tripp
Counsel

JTBT/mlr

444 Park Avenue South New York, New York 10016 212 686-4191
OFFICES IN: NEW YORK, NY (NATIONAL HEADQUARTERS); WASHINGTON, DC; BERKELEY, CA; BOULDER, CO
RICHMOND, VA.

June 20, 1983

Socio-Economics
Branch

Environmental Defense Fund
ATTN: Mr. James T. B. Tripp, Counsel
444 Park Avenue, South
New York, New York 10016

Dear Mr. Tripp:

Reference your letter of April 18, 1983 requesting a copy of Appendix B, the Economics Appendix, to the Draft Interim Feasibility Report and Environmental Impact Statement for Oliver Lock Replacement.

We have now completed Appendix B and are attaching a draft copy to this letter. If you have any questions or comments regarding the attached, please contact Mrs. Glenda C. Smith, Economist, Planning Division, (205) 694-3843.

Sincerely,

Lawrence R. Green
Chief, Planning Division

Attachment

FEDERAL ENERGY REGULATORY COMMISSION
REGIONAL OFFICE
730 Peachtree Street, N. E.
Atlanta, Georgia 30308
April 18, 1983

District Engineer
Corps of Engineers
Department of the Army
Post Office Box 2288
Mobile, Alabama 36628

Dear Sir:

This is in response to a letter dated April 6, 1983, from Mr. Lawrence R. Green, requesting the latest power values for the final report of Interim Feasibility Study and Environmental Impact Statement for Oliver Lock Replacement.

Due to staffing problems, work can only be done as time permits between higher priority assignments. However, we will do all we can to expedite your request. Should you have any questions, feel free to call Mr. John W. Snellgrove, FTS 257-4134.

Comments on the draft will be sent under a separate letter.

Very truly yours,

Aarne O. Kauranen
Acting Regional Engineer

FEDERAL ENERGY REGULATORY COMMISSION
WASHINGTON, D.C. 20426

IN REPLY REFER TO:

OEPR-DHL-HBPS
Federal Project Review
Draft Interim Feas.
Report & EIS
Oliver Lock Replacement
Black Warrior-Tombigbee
Rivers, Alabama

Mr. Lawrence R. Green
Chief, Planning Division
Mobile District Corps of Engineers
P. O. Box 2288
Mobile, Alabama 36628

Attention: Western Basins Branch

Dear Mr. Green:

This is in response to your letter of March 17, 1983, to the Advisor on Environmental Quality of the Commission requesting comments on the draft interim feasibility report and environmental impact statement on the Oliver Lock Replacement, Black Warrior-Tombigbee Rivers, Tuscaloosa, Alabama.

The study evaluated engineering, economic, and environmental feasibility for solving traffic delay problems due to the small lock chamber size at the Oliver Lock and Dam. The selected plan consists of constructing a new 110 x 600-foot-lock located 2,700 feet downstream of the existing dam and installation of a 16.3-megawatt powerplant on the opposite bank from the lock. The powerplant would produce 43,500,000 kilowatt-hours of average annual energy.

According to the report, an increase in the pool elevation at Oliver Lock and Dam to provide ponding operation would decrease the power generation at the existing Holt powerplant located about 8.8 miles upstream of Oliver Lock and Dam. The benefits resulting from regulated discharges from Holt and other upstream projects operating in concert with the Oliver plant was not evaluated. The report does not include an analysis of the costs, benefits, and impacts of increasing the pool elevation to provide power pondage.

The economic analysis presented in the report does not clearly indicate that a powerplant of 16.3 megawatts would be the optimum size providing maximum net annual benefits. The lack of other data such as head duration curves, turbine performance characteristics, and power duration curves for various plant sizes evaluated prevented a thorough review by our staff. However, cursory analysis by the staff based on the information provided in the draft report indicates that a larger installation, in the range of 20,000-25,000 kilowatts, may be economically feasible. Further refinements of construction costs and power benefits may bear this out.

An application for a preliminary permit for studies of non-Federal power installations at Oliver Lock and Dam has been submitted by the Alabama Municipal

Electric Authority on November 26, 1982. A preliminary permit allows the permittee to maintain priority of application for license over other non-Federal entities while conducting investigations and securing data to determine project feasibility and preparing an acceptable application for license. The actual issuance of a license would be carefully considered in relation to any plans of the Corps of Engineers and FERC/Corps Memorandum of Understanding and would, of course, be coordinated with all entities involved. The Commission staff is currently reviewing the permit application.

Based on the consideration of your report and our staff studies, we conclude that hydropower development at Oliver Lock and Dam is economically feasible and that later, more detailed studies reflecting current costs and benefits, operation coordination with existing upstream powerplants, and other site specific conditions will better determine the optimum capacity.

Sincerely,

Lawrence R. Anderson

Lawrence R. Anderson, Director
Office of Electric Power Regulation

FEDERAL ENERGY REGULATORY COMMISSION

REGIONAL OFFICE

730 Peachtree Street, N. E.
Atlanta, Georgia 30308
May 9, 1983

District Engineer
Corps of Engineers
Department of the Army
Post Office Box 2288
Mobile, Alabama 36628

Dear Sir:

This is in response to a letter dated April 6, 1983, from Mr. Lawrence R. Green, requesting the latest power values for the final report of Interim Feasibility Study and Environmental Impact Statement for Oliver Lock Replacement. The enclosed data updates the power values in your draft report based on plant factors of 15, 30, 35, and 50 percent. The values are based on July 1982 interest rates for Federal financing of 7-7/8 percent and private financing of 13-1/2 percent.

Our estimates of the value of power from hydroelectric projects are based on the cost of producing power at modern alternative electric generating plants, using the methodology described in "Hydroelectric Power Evaluation," DOE/FERC-0031, dated August 1979. The total value is composed of a "capacity component" which corresponds to the fixed capital charges and fixed operating costs of the alternative electric plant and transmission facilities, and an "energy component" which corresponds to the other operating expenses which are variable in nature and generally dependent upon the number of kilowatt-hours generated.

The present procedure is to develop values assuming a 7-1/2 percent plant factor for combustion turbine units, 25 percent for combined cycle units, and 55 percent for coal-fired units. These plant factors are assumed to be the equivalent average lifetime plant factor of the unit type in question. In order for the alternatives to be comparable, certain adjustments are applied. One is to compensate for the difference in plant factor of the alternatives and the proposed hydro project; another is for the difference in energy costs of the alternative and the system energy costs of the plants which the alternatives would displace; and a

third adjustment takes into consideration the rapid response to load changes provided by hydroelectric projects. In some cases, these adjustments can have a significant influence on the power value of a hydro project.

Three alternatives were computed using July 1982 capital installed cost in Power Supply Area 22. First, with a 15-percent capacity factor, would be a combustion turbine generating plant. The capital installed cost of providing combustion turbine capacity amounts to about $275 per kilowatt for private and $263 per kilowatt for Federal financing, including the step-up substation. This is based on two 75,000-kilowatt units burning oil. Second, with a 30-percent capacity factor, would be a combined cycle generating plant. The capital installed cost of providing combined cycle capacity amounts to about $471 per kilowatt for private and $448 for Federal financing, including the step-up substation. This is based on two 400,000-kilowatt units burning oil. The cost of oil as of December 1982 was 706.3 cents per million Btu. Third, with a 35-percent and 50-percent capacity factor, would be a coal-fired steam-generating plant. The capital installed cost of providing coal-fired capacity amounts to about $1,308 per kilowatt for private and $1,127 per kilowatt for Federal financing, including the step-up substation and SO_2 removal. This is based on two 800,000-kilowatt units. The cost of coal as of December 1982 was 209.6 cents per millin Btu.

Energy values given are based on current fuel cost levels escalated for real fuel price increases. Escalated real fuel costs assume a 1985 project-on-line date and various percentages cost of money to levelize them over the 100-year life of the hydroelectric plant. The escalation rates beyond 30 years were assumed to continue at the same rate as that at the end of 30 years. Real fuel cost escalation factors were taken from Department of Energy data published in the Federal Register, Vol. 46, No. 222, November 18, 1981.

The estimated fixed charge with Federally-financed value of 7-7/8 percent is 8.78 percent. Based on private financing of 13-1/2 percent, the fixed charge is 18.39 percent. Using the fixed charge rates and other alternative costs, we estimate the values of power to be as follows:

Type of Financing	Adjusted Capacity Value ($/kW/yr)	Escalated Energy Value (Mills/kWh)	Equivalent Total Power Value 1/ ($/kW/yr)	(Mills/kWh)
		Combustion Turbine Alternative (15 Percent Hydro Capacity)		
Federal	1.85	206.85	273.65	208.25
Private	37.40	162.60	251.05	191.05
		Combined Cycle Alternative (30 Percent Hydro Capacity)		
Federal	26.90	146.45	411.75	156.70
Private	82.70	114.60	383.85	146.05
		Coal-Fired Alternatives (35 Percent Hydro Capacity)		
Federal	130.05	44.65	266.95	87.05
Private	288.05	42.95	419.75	136.90
		(50 Percent Hydro Capacity)		
Federal	128.30	44.65	323.85	73.95
Private	286.00	42.95	474.10	108.25

1/ Example: Component power values of $37.40/kW/yr and 162.60 mills/kWh at 15 percent hydro capacity (private financing) are equivalent to a total annual value of either $251.05/kW/yr or 191.05 mills/kWh (but not both).

The estimates of power values for the Oliver Lock and Dam, based on the cost of the Federally-financed alternative plant, are furnished per your request.

Very truly yours,

Aarne O. Kauranen
Acting Regional Engineer

cc: SEPA

cc: Div. Engr.
Atlanta, GA

GRAY, ESPY AND NETTLES
ATTORNEYS AT LAW
2728 EIGHTH STREET
P. O. BOX 2786
TUSCALOOSA, ALABAMA 35403

WILLIAM P. GRAY, JR.
ISAAC P. ESPY
THOMAS A. NETTLES, IV

AREA CODE 205
PHONE 758-5591

April 18, 1983

Col. Patrick J. Kelly
District Engineer
Mobile District, Corps of Engineers
P.O. Box 2288
Mobile, AL 36628

RE: Interim Feasibility Report and Environmental Impact Statement for Oliver Lock Replacement

Dear Colonel Kelly:

Pursuant to the announcement of a public hearing on the referenced project, and the invitation to present written statements for the official record, on behalf of McAbee Construction, Inc., I submit the comments which follow.

Interest

McAbee Construction, Inc., holds legal title to 53 acres of property affected by the referenced project. This property is located in the East half of the Southeast Quarter of Section 20, and in the West half of the Southwest Quarter of Section 21, all in Township 21 South, Range 10 West, Tuscaloosa County, Alabama. Complete legal descriptions are attached as exhibits "A" and "B" to this letter, and may be found of record in the Office of the Judge of Probate of Tuscaloosa County, Alabama, in Deed Book 765 at page 81, and in Deed Book 815 at page 313.

This parcel of property is wholly located within the "project area" as shown on the plate on page C-I-3 of the Interim Report. Exhibit "C" is a plat prepared by me, referencing the state plane coordinate system, the boundaries of the McAbee Construction, Inc., property, and the powerhouse as shown on alternative No. 2, appendix A, Chart III - 2 of the Interim Report. Exhibit "C" shows that under alternative No. 2, the powerhouse and south-side,

downstream, rock wall will be on the McAbee Construction, Inc. property, and will completely block access from the property to the river.

Nature of the Interests

The major part of the McAbee Construction, Inc., land was purchased in April of 1978. Since that time there has been continual work on the property. A topographic survey and plat was obtained, and proposed improvement was designed. The initial and continuing purpose for the property was for use as industrial property.

Based on the survey and plans, the property has been cleared, filled and shaped.

Based upon the owner's experience and knowledge, it is believed that there is no other existing undeveloped, but ready-for-development, property like it in Tuscaloosa County. It adjoins river, road, and railroad. Certainly, it is the finest property of its kind left in the County.

The owner is not a speculator, but has for twenty years had its headquarters in Tuscaloosa County as a major mechanical and industrial fabricator and contractor. It regularly performs work from Florida to New York and westward to the Mississippi.

There exist current, feasible plans for actual development made contingent only because of the uncertainty of the location and extent of taking for the referenced project.

Comments

McAbee Construction, Inc., is in complete support of an upgrading or replacement of the Oliver Lock and Dam to maximize commerce on the Warrior-Tombigbee and Tennessee-Tombigbee systems. It urges, however, that the location and construction of this facility be done so as to neither delay nor destroy the use of its property.

In addition to its obvious worth to its owner, this property represents an enormous asset to the County because of the industrial jobs which may be created and located on the property.

McAbee Construction, Inc., requests that the Corps of Engineers:

1. Thoroughly investigate the current condition and potential use of the property of McAbee Construction, Inc.

2. Consider, in calculating benefit/cost ratios for the proposed alternative sites, the potential use of the McAbee Construction, Inc., property as a prime industrial site capable of, among other things, siting new industrial capacity and employment opportunities.

3. Consider the impact on McAbee Construction, Inc., lands by the location of transformer facilities, high voltage line rights-of-way, ingress to generating facilities, parking, and temporary but long-term construction area requirements.

4. Consider the impact on development of the McAbee Construction, Inc., property by the uncertainty caused by the time required to (a) decide on a location, (b) prepare working drawings, (c) obtain authorization and appropriation, and (d) actually acquire specific property.

Summary

McAbee Construction, Inc., stands ready and available to assist in the evaluation of the problems raised in this statement, and in the orderly resolution of them. It appreciates the general public benefit of this project and requests only that the specific and special effect on its property be ameliorated.

Sincerely yours,

GRAY, ESPY AND NETTLES

Isaac P. Espy

Isaac P. Espy

IPE/mcs

RESPONSE TO ISAAC P. ESPY, ATTORNEY FOR MCABEE CONSTRUCTION INC.:

Comments are acknowledged. If Alternative No. 2 is selected, river access to the land will be denied and the potential or lost opportunity will be considered when determining purchase price. Location of power lines will likely abut land purchased for access to powerhouse.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE
Washington, D.C. 20230

April 27, 1983

N/MB2x5:VLS

TO: PP2 - Joyce Wood

FROM: N - K. E. Taggart

SUBJECT: DEIS 8303.14 - Oliver Lock Replacement, Black Warrior-Tombigbee Rivers, Alabama (U.S. Army Corps of Engineers, Mobile District)

The subject statement has been reviewed within the areas of the National Ocean Service Office of Charting and Geodetic Services' (C&GS) responsibility and expertise, and in terms of the impact of the proposed action on C&GS activities and projects.

Geodetic control survey monuments may be located in the proposed project area. If there is any planned activity which will disturb or destroy these monuments, C&GS requires not less than 90 days notification in advance of such activity in order to plan for their relocation. For further information about these monuments, please contact Mr. John Spencer, Chief, National Geodetic Information Branch (N/CG17), or Mr. Charles Novak, Chief, Network Maintenance Section (N/CG162), at 6001 Executive Boulevard, Rockville, MD 20852.

RESPONSE TO NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION:

There are no Geodetic control survey monuments located within the area impacted by this study.

Department of Energy
Southeastern Power Administration
Elberton, Georgia 30635

April 28, 1983

Mr. Lawrence R. Green
Chief, Planning Division
U. S. Army Engineer District, Mobile
Corps of Engineers
Post Office Box 2288
Mobile, Alabama 36628

Dear Mr. Green:

The Southeastern Power Administration did not receive the Draft Interim Feasibility Report and Environmental Impact Statement for Oliver Lock Replacement until April 25, 1983. Due to previously scheduled commitments, we are unable to complete our evaluation by May 9, 1983. We respectfully request that our comments on the report be considered at a later date. A concerted effort will be made to complete the review as soon as possible.

Mr. John Mixon of my staff is coordinating with Mr. Bill Reid and other members of the Mobile District staff to obtain the necessary information and data that will be required for our evaluation of the available hydroelectric power that can be marketed from the Oliver Project.

Sincerely,

Harold H. Jones, Jr.
for
Jim B. Lloyd
Chief, Division of Power Operations

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Washington D C 20235
OFFICE OF THE ADMINISTRATOR

May 2, 1983

Mr. Willis E. Ruland
Chief, Environment and
Resources Branch
Mobile District, Corps of Engineers
Department of the Army
P.O. Box 2288
Mobile, Alabama 36628

ATTN: Environmental Studies and Evaluation Section

Dear Mr. Ruland:

This is in reference to your draft environmental impact statement on the Oliver Lock Replacement, Black Warrior-Tombigbee Rivers, Tuscaloosa, Alabama. Enclosed are comments from the National Oceanic and Atmospheric Administration.

Thank you for giving us an opportunity to provide these comments, which we hope will be of assistance to you. We would appreciate receiving two copies of the final environmental impact statement.

Sincerely,

Joyce M. Wood
Chief
Ecology and Conservation Division

Enclosure

United States Department of the Interior
OFFICE OF ENVIRONMENTAL PROJECT REVIEW
Southeast Region / Suite 1384
Richard B. Russell Federal Building
75 Spring Street, S.W. / Atlanta, Ga. 30303

May 2, 1983

ER-83/397

Colonel Patrick J. Kelly
Commander and District Engineer
U.S. Army Engineer District, Mobile
Post Office Box 2288
Mobile, Alabama 36628

Dear Colonel Kelly:

The Department of the Interior has reviewed the Draft Environmental Impact Statement and Draft Interim Feasibility Report for Oliver Lock Replacement, Tuscaloosa County, Alabama, and has the following comments.

Water Resources

The recommended plan may affect stream gages operated by the U.S. Geological Survey on the Black Warrior River at Northport and at Tuscaloosa. Consideration should be given to ensuring continued operation of the gages.

Fish and Wildlife Resources

Draft Environmental Impact Statement

Section 5.0, pp. EIS 19-27. We concur with the assessment of environmental impacts of the actions as presented in this section.

Draft Interim Feasibility Report (DIFR)

We do not believe the DIFR is adequate in its coverage of mitigative measures to minimize fish and wildlife resource impacts resulting from implementation of any of the plans. The Draft Fish and Wildlife Coordination Act (DFWCA) Report submitted by the U.S. Fish and Wildlife Service on February 10, 1983, contains recommendations which, if implemented into project plans, will minimize impacts to fish and wildlife resources.

The DFWCA Report has been attached in Appendix D to your document. However, recommendations contained in the DFWCA are not discussed in the DIFR and apparently have not been incorporated into project plans. These recommendations (Page D-II-14) should be discussed in the document and if not incorporated into project plans, reasons for not doing so should be stated.

Thank you for the opportunity to comment on this draft environmental impact statement and interim feasibility report.

Sincerely,

James H. Lee

James H. Lee
Regional Environmental Officer

RESPONSE TO DEPARTMENT OF INTERIOR:

Comments are acknowledged. The main text of the report was changed to reflect the US Fish & Wildlife Service's concern for limiting erosion, sedimentation and turbidity. We cannot respond positively to the recommendation that disposal areas be revegetated with hardwoods and dedicated for fish and wildlife since we will not retain fee ownership of these lands. The suggestion that lands associated with the existing facility be dedicated for fish and wildlife purposes if the downstream site is selected cannot be implemented since they are of such small size as to be unmanageable. Additionally, these lands most probably will be used to reduce the cost of the Federal project by exchanging them for land necessary for the proposed project.

Advisory Council On Historic Preservation

1522 K Street, NW
Washington, DC 20005

MAY 3 1983

Colonel Patrick J. Kelly
District Engineer
Mobile District
Army Corps of Engineers
P.O. Box 2288
Mobile, AL 36628

Dear Colonel Kelly:

We have received and reviewed the Draft Environmental Impact Statement (DEIS), and Draft Interim Feasibility Report for the Oliver Lock Replacement, Black Warrior-Tombigbee Rivers, Tuscaloosa, Alabama. In accordance with the National Environmental Policy Act, we have the following comments.

The results of the archeological survey to date look fine. As the Corps acknowledges on pages 1, 2, and 18 of the DEIS, further evaluation of 10 of the 49 identified archeological sites will be necessary if the project moves forward. We wish to remind the Corps of its responsibility to consult with the Alabama State Historic Preservation Officer (SHPO), and the Council in accordance with 36 CFR Part 800, if properties eligible for the National Register of Historic Places would be directly or indirectly affected by the lock replacement or associated hydropower facilities.

If you have any questions about these comments or need assistance, please contact Staff Archeologist Ronald Anzalone at 202-254-3974 (an FTS number).

Sincerely,

Don L. Klima
Chief, Eastern Division
of Project Review

RESPONSE TO ADVISORY COUNCIL ON HISTORIC PRESERVATION:

The compliance with ER 1105-2-50 and 36 CFR Part 800, the Alabama State Historic Preservation Officer (SHPO) was provided a copy of the final report for this project on September 27, 1983. Throughout the project the SHPO has been kept abreast of all cultural resource plans and coordination will continue with that office as well as other Federal agencies as required.

DEPARTMENT OF TRANSPORTATION
UNITED STATES COAST GUARD

ADDRESS REPLY TO
COMMANDER (dpl)
EIGHTH COAST GUARD DISTRICT
HALE BOGGS FEDERAL BLDG
500 CAMP ST
NEW ORLEANS LA 70130
FTS 682-2961

16475
5 MAY 1983

From: Commander, Eighth Coast Guard District
To: District Commander, Mobile District, Corps of Engineers

Subj: Draft Interim Feasibility Report and DEIS, Oliver Lock Replacement, Black Warrior-Tombigbee Rivers, Tuscaloosa, Alabama

1. Thank you for the opportunity to comment on this project. We have reviewed the Draft Feasibility Report and DEIS and have no comments on the proposal.

Deborah M. Dupree
DEBORAH M. DUPREE
By direction

RESPONSE TO US COAST GUARD:

Comments are acknowledged, no response is necessary.

United States
Department of
Agriculture

Soil
Conservation
Service

P. O. Box 311
Auburn, AL
36830

May 6, 1983

Mr. Lawrence R. Green
Chief, Planning Division
Department of the Army
Corps of Engineers
P. O. Box 2288
Mobile, Alabama 36628

Dear Mr. Green:

A copy of the Draft Interim Feasibility Report and Draft Environmental Impact Statement (DEIS) on the Oliver Lock Replacement, Black Warrior-Tombigbee Rivers, Tuscaloosa, Alabama was forwarded to the Soil Conservation Service in Alabama for review. We have made the necessary review and have no comments or suggestions to offer.

We appreciate having the opportunity to review and comment on this document.

Sincerely,

Ernest V. Todd

Ernest V. Todd
State Conservationist

RESPONSE TO SOIL CONSERVATION SERVICE:

Comments are acknowledged, no response is necessary.

THE PENNSYLVANIA STATE UNIVERSITY
RESEARCH BUILDING B
UNIVERSITY PARK, PENNSYLVANIA 16802

The Pennsylvania Transportation Institute

Area Code 814
865-1891

May 10, 1983

District Engineer
U.S. Army Engineer District, Mobile
109 St. Joseph Street
P.O. Box 2288
Mobile, AL 36628

Dear Sir:

Thank you for sending a copy of the Draft Interim Feasibility Report for Oliver Lock Replacement as requested in my April 28, 1983 letter. The report sent, however, was missing Appendix B, "Economics." Would you therefore please send Appendix B?

Sincerely,

J. L. Carroll

Joseph L. Carroll, Director
Transportation Systems Program

JLC:als

HUBBARD, WALDROP, TANNER & deGRAFFENRIED
ATTORNEYS AT LAW
[illegible] LURLEEN WALLACE BLVD. NORTH
P.O. BOX [illegible]
TUSCALOOSA, ALABAMA [illegible]
PHONE [illegible]

PERRY HUBBARD
H. VANN WALDROP
ROBERT C. TANNER
W. RYAN deGRAFFENRIED, JR.

ASSOCIATES:
JUNIUS F. GUIN, III
ROBERT F. REYNOLDS
NEEDHAM C. MALLORY*
BRUCE P. ELY
KIM INGRAM LARY
JAMES D. SMITH
*ALSO ADMITTED IN GEORGIA
GWIP LINE [illegible]

May 11, 1983

Department of the Army
Mobile District
Corps of Engineers
P.O. Box 2288
Mobile, Alabama 36628

RE: INTERIM FEASIBILITY REPORT FOR OLIVER LOCK REPLACEMENT, BLACK WARRIOR-TOMBIGBEE RIVERS, ALABAMA

Gentlemen:

This letter is written on behalf of The Country Club of Tuscaloosa, Inc. ("TCC") in my capacity as attorney for same and is designed to provide a written statement of TCC's position taken at a public hearing on April 12, 1983, in Tuscaloosa, Alabama in response to the above-referenced Interim Feasibility Report and Environmental Impact Statement for Oliver Lock Replacement.

I will organize the written response of TCC in the following numerical paragraphs:

1. Although TCC whole-heartedly endorses the favorable economic benefits which will result from the replacement of the Oliver Lock for the reasons listed below, TCC must stand in opposition to any of the four alternatives thus far proposed by the Corps.

2. TCC's opposition stems not from a general disenchantment or opposition to the project but rather from the Corps' failure to thus-far adequately explain its plans with respect to minimizing the effect of the planned lock replacement on TCC's facilities and operations.

3. The public meeting of April 12, 1983 was followed by a smaller meeting with representatives of the Corps on April 29, 1983 here in Tuscaloosa, Alabama. I would also point out in this written statement what we publicly stated at the meeting held on April 12, 1983, to wit: TCC appreciates the cooperation and attitude thus far exhibited by the Corps in attempting to work out the particular effects of the proposed project on TCC.

4. It is the understanding of TCC that at present Alternatives 2 and 4 are the two Alternatives seriously being considered for construction of the replacement lock. TCC has no particular preference for either Alternative but finds each possessing certain decided advantages and disadvantages and would be in favor of either Alternative assuming acceptable arrangements for the continued activities of TCC can be arranged.

5. The specific concern that TCC has is receiving assurances from the Corps that its existing facilities, primarily the golf course, can be redesigned and relocated so as to assure the continued operation of TCC after the lock replacement. Moreover, TCC is equally concerned that acceptable arrangements can be made to assure the uninterrupted operation of its facilities during the construction.

   a. TCC is particularly concerned that construction activity and relocation of its facilities be done in a fashion so as not to have any interruption of its activities. For example, if play on the golf course were to be interrupted for any period of time, whether because of construction activities or because the golf course was relocated but not playable for several months, membership would immediately fall off and it is doubtful that TCC could survive the relocation.

b. Therefore, it is imperative to TCC that it have specific assurances from the Corps showing how its facilities can be relocated and reorganized and its operations conducted without interruption.

c. It appears to TCC that relocation of the golf course will be mandated because either Alternative 2 or 4 affects five or six holes of play. The timing of the relocation of the golf course would be critical. In order for a playable golf course to exist in 1985 and 1986 when construction begins, relocation and reconstruction of the golf course would have to take place during 1983 and 1984.

d. TCC strongly urges the Corps to consider immediate allocation of funds during 1983 for relocation of the golf course and compensation to TCC for the disruption of its activities.

5. The Corps has furnished TCC with the name of an independent contractor who has been employed to survey feasible methods for relocation of the golf course. Until such time as this independent contractor and the Corps have provided TCC with detailed plans for the relocation and redesign of TCC's facilities and a timetable to accomplish same that will not result in any dispution of TCC's business. TCC must continue its opposition to any of the four alternatives proposed.

Respectfully submitted,

THE COUNTRY CLUB OF
TUSCALOOSA, INC.

Robert C. Tanner
Attorney

RCT/bc

RESPONSE TO ROBERT C. TANNER, ATTORNEY FOR THE COUNTRY CLUB OF TUSCALOOSA, INC.:

Comment acknowledged. As noted, the Mobile District has retained a consultant with the capability of suggesting a redesign of the golf course. In a related issue, a report concerning bank erosion protection at the Country Club has been written and is currently pending a determination as to which alternative will be selected in the interim study. If the downstream site, Alternative No. 2, is selected, funds for the proposed riprap bank protection would be better spent by purchasing Country Club lands which are eroding but would be required for construction of the proposed lock, dam, and powerhouse thus providing the Country Club funds for reconstruction.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IV
345 COURTLAND STREET
ATLANTA, GEORGIA 30365

MAY 16 1983

4PM-EA/GM

Mr. Lawrence R. Green
Chief, Planning Division
U.S. Army Corps of Engineers, Mobile
P.O. Box 2288
Mobile, Alabama 36628

Dear Mr. Green:

We have reviewed the Draft Environmental Impact Statement on the Oliver Lock Replacement, Black Warrior-Tombigbee River, Tuscaloosa County, Alabama. From our evaluation of the document it does not appear that these improvements will result in excessive environmental losses. It should be noted that while water quality in the Oliver Pool has improved in the last decade, sags in the dissolved oxygen levels are still noted during hot weather, low-flow conditions. Since this is generally when most of the releases occur for power production, modifications to the turbines and inlet structures should be investigated. The cost of improving oxygen levels in the release water would be far less expensive with a built-in design rather than retrofitting the turbines.

On the basis of our review, a rating of LO-2 was assigned. That is, we do not anticipate any significant adverse environmental consequences, however, we do request some additional information on how the dissolved oxygen issue will be addressed.

If we can be of any further assistance, please do not hesitate to contact us.

Sincerely yours,

Sheppard N. Moore

Sheppard N. Moore, Chief
Environmental Review Section
Environmental Assesment Branch

RESPONSE TO ENVIRONMENTAL PROTECTION AGENCY:

We concur with your comment. Water quality in Oliver Pool has improved significantly in recent years to the point where dissolved oxygen (DO) levels rarely drop below state DO water quality standards. Nevertheless, wise planning behooves us to investigate and, if feasible, incorporate where possible, as many measures that would assure or improve further the DO levels immediately downstream from the Oliver Dam. A number of aeration devices will be investigated during the advanced engineering and design phase of this project once construction funds have been allocated by Congress. These devices include the following: subsurface aerators such as ducted propellers, diffusion aerators which inject air or oxygen below the surface, water spray aerators, turbine aerators, white water generators, weirs, cascades, and U-tube aerators which take advantage of the increase of gas saturation content with depth.

Paragraph 5.12 in the EIS has been modified to include portions of this discussion.

STATE OF ALABAMA

OFFICE OF STATE PLANNING AND FEDERAL PROGRAMS

135 S. Union Street • Montgomery, Alabama 36130-5601 • (205) 832-6963

GEORGE C. WALLACE
GOVERNOR

May 26, 1983

TO: Mr. Lawrence R. Green, Chief, Planning Division
U. S. Army Corps of Engineers
Mobile District
P. O. Box 2288
Mobile, AL 36628
Attn: Western Basins Branch

William M. Rushton

FROM: William M. Rushton, Director
Office of State Planning and Federal Programs
Attention: State Clearinghouse

SUBJECT: DIRECT ENVIRONMENTAL IMPACT STATEMENT

Applicant: U. S. Corps of Engineers

Project: Draft Interim Feasibility Report and Draft Environmental Impact Statement for Oliver Lock Replacement, Black Warrior-Tombigbee Rivers, Alabama.

State Clearinghouse Control Number: OSP-012-83

The above Draft Environmental Impact Statement has been reviewed by the appropriate State agencies in accordance with Office of Management and Budget Circular A-95, Revised.

The comments received from the reviewing agencies are attached.

Please contact us if we may be of further assistance. Correspondence regarding this proposal should refer to the assigned Clearinghouse Number.

If you have any questions regarding this project, please call Donna Snowden, telephone 832-3940.

A-95/06
Attachments
Agencies contacted for comment:
- West AL Planning and Development Council
- Birmingham Regional Planning Commission
- Alabama-Tombigbee Regional Commission
- South AL Regional Planning Commission
- Dept. of Agriculture & Industries
- Conservation & Natural Resources - White
- Soil & Water Conservation
- Forestry Commission
- AL Dept. of Environmental Management
- Historical Commission
- Geological Survey of Alabama
- Alabama State Docks
- State Planning - Wallace
- State Planning - Stevenson

REQUEST FOR REVIEW OF PROJECT NOTIFICATION

TO: Mr. Lewis E. McCray, Director   Number: OSP-012-83
West AL Planning and Development Council

Applicant: U. S. Corps of Engineers

Project: Draft Interim Feasibility Report and Draft Environmental Impact Statement for Oliver Lock Replacement, Black Warrior-Tombigbee Rivers, Alabama.

Date: MAR 23, 1983   Return Prior to: MAY 2, 1983

Please review the attached Environmental Impact Statement and indicate your comment with respect to any environmental impact involved.

Comments: (Please check one block.)

X No comment (Environmental Impact Statement is in order and no additional comments are offered.)

Comments (Elaborate below.)

Comment here:

RECEIVED
APR 26 1983
State Clearinghouse

RECEIVED
'83 MAR 24 AM 8 20
WEST AL. PLANNING
& DEVELOPMENT COUNCIL

Lewis E. McCray
Signature

Please Return Original to:

Office of State Planning
and Federal Programs
135 S. Union Street
Montgomery, AL 36130-5601

D-V-42

FORM CH-4
1/81

TO: Office of State Planning and Federal Programs
135 S. Union Street
Montgomery, AL 36130-5601

WEST ALABAMA PLANNING and DEVELOPMENT COUNCIL

FROM: Lewis E. McCray
West Alabama Planning and Development Council
Tuscaloosa Municipal Airport Terminal Building
2nd Floor
Northport, AL 35476

SUBJECT: A-95 Summary Recommendations

APPLICANT: U. S. Corps of Engineers

PROJECT: Draft Feasibility Report and EIS for Oliver Lock Replacement

DATE OF APPLICATION: ______ FEDERAL CATALOG NO. ______

DATE A-95 COMMENTS FORWARDED BY CLEARINGHOUSE TO APPLICANT April 25, 1983

The above project has been reviewed by the Regional Clearinghouse, West Alabama Planning and Development Council in accordance with the Office of Management and Budget Circular A-95, Revised.

The Clearinghouse recommendations are indicated below. This recommendation with attached comments from other sources, if any, must be included with your application for submittal to the appropriate State or Federal agency.

[X] Concurrence (Support)

COMMENTS: ______

[ ] Additional Comments Attached

[ ] Concurrence With Conditions (Support only with conditions. Indicate major reservations about the project and the specific substantive changes or modifications desired.)

CONDITIONS: ______

[ ] Additional Comments Attached

[ ] Non-Concurrence (Do not support. Summarize the major reasons for recommended disapproval including documentation or references to plans, statutes, regulations, etc., which substantiates disapproval.)

COMMENTS: ______

[ ] Additional Comments Attached.

[ ] NO COMMENT - (Although the clearinghouse may not wish to take a formal position, technical comments of the staff may be attached with comments from other reviews.)

[ ] Additional Comments attached.

Lewis E. McCray
Executive Director

REQUEST FOR REVIEW OF PROJECT NOTIFICATION MAR 24 1983

TO: Mr. Robert M. Hope
Alabama State Docks

Number: OSP-012-83

Applicant: U. S. Corps of Engineers

Project: Draft Interim Feasibility Report and Draft Environmental Impact Statement for Oliver Lock Replacement, Black Warrior-Tombigbee Rivers, Alabama.

Date: MAR 23, 1983

Return Prior to: MAY 2, 1983

Please review the attached Environmental Impact Statement and indicate your comment with respect to any environmental impact involved.

Comments: (Please check one block.)

No comment (Environmental Impact Statement is in order and no additional comments are offered.)

Comments (Elaborate below.)

Comment here:

In reviewing plans, it appears that this project will require the use of some land owned by the Alabama State Docks Department. The use of this land will, of course, reduce the amount of land available to the Department for expansion of its inland dock facility. If the Department is required to give up this property, we were considering acquiring, if possible, some of the property adjacent to the Department's dock facility located near the existing dam and lock. We would like to discuss this matter with the appropriate personnel.

RECEIVED

APR 22 1983

Signature
W. H. Black, Jr.
Chief Administrative Officer

Please Return Original to:

Office of State Planning
and Federal Programs
135 S. Union Street
Montgomery, AL 36130-5601

D-V-44

FORM CH-4
1/81

RESPONSE TO ALABAMA STATE DOCKS (MR. W. H. BLACK, JR.):

Comment acknowledged. A preliminary meeting to discuss the possibility of a land exchange was held with Mr. Black and Mr. Green in Mobile on June 3, 1983.

REQUEST FOR REVIEW OF PROJECT NOTIFICATION

TO: Mr. George Alford, Director
Alabama-Tombigbee Regional Comm.

Number: OSP-012-83

Applicant: U. S. Corps of Engineers

Project: Draft Interim Feasibility Report and Draft Environmental Impact Statement for Oliver Lock Replacement, Black Warrior-Tombigbee Rivers, Alabama.

Date: MAR 23, 1983

Return Prior to: MAY 2, 1983

Please review the attached Environmental Impact Statement and indicate your comment with respect to any environmental impact involved.

Comments: (Please check one block.)

X No comment (Environmental Impact Statement is in order and no additional comments are offered.)

Comments (Elaborate below.)

Comment here:

RECEIVED

APR 18 1983

State Clearinghouse

Paul T. Foxworth
Signature

Please Return Original to:

Office of State Planning
and Federal Programs
135 S. Union Street
Montgomery, AL 36130-5601

D-V-46

FORM CH-4
1/81

REQUEST FOR REVIEW OF PROJECT NOTIFICATION

TO: Mr. Richard D. Pruitt, Director
South AL Regional Planning Comm.

Number: OSP-012-83

Applicant: U. S. Corps of Engineers

Project: Draft Interim Feasibility Report and Draft Environmental Impact Statement for Oliver Lock Replacement, Black Warrior-Tombigbee Rivers, Alabama.

Date: MAR 23, 1983

Return Prior to: MAY 2, 1983

Please review the attached Environmental Impact Statement and indicate your comment with respect to any environmental impact involved.

Comments: (Please check one block.)

✓ No comment (Environmental Impact Statement is in order and no additional comments are offered.)

Comments (Elaborate below.)

Comment here:

RECEIVED
MAR 28 1983
State Clearinghouse

Donald A. Bealy
Signature

Please Return Original to:

Office of State Planning
and Federal Programs
135 S. Union Street
Montgomery, AL 36130-5601

D-V-47

FORM CH-4
1/81

REQUEST FOR REVIEW OF PROJECT NOTIFICATION

TO: Mr. Walter Stevenson
State Planning

Number: OSP-012-83

Applicant: U. S. Corps of Engineers

Project: Draft Interim Feasibility Report and Draft Environmental Impact Statement for Oliver Lock Replacement, Black Warrior-Tombigbee Rivers, Alabama.

Date: MAR 23, 1983

Return Prior to: MAY 2, 1983

Please review the attached Environmental Impact Statement and indicate your comment with respect to any environmental impact involved.

Comments: (Please check one block.)

No comment (Environmental Impact Statement is in order and no additional comments are offered.)

✓ Comments (Elaborate below.)

Comment here:

Project appears to be environmentally sound and will remove a bottleneck on the BWT waterway.

RECEIVED
APR 7 1983
State Clearinghouse

Walter Stevenson
Signature

Please Return Original to:

Office of State Planning
and Federal Programs
135 S. Union Street
Montgomery, AL 36130-5601

D-V-48

FORM CH-4
1/81

Department of Energy
Southeastern Power Administration
Elberton, Georgia 30635

August 12, 1983

District Engineer
U. S. Army Engineer District, Mobile
Corps of Engineers
P. O. Box 2288
Mobile, Alabama 36628

Dear Sir:

We are writing in response to a request dated July 11, 1983, from Mr. Bob Meader to Mr. John Mixon of SEPA in regard to the financial feasibility of adding power to the Oliver Lock Replacement.

Our preliminary analysis indicates that power will be feasible when considered as an integral part of the integrated Georgia-Alabama System of Projects. In our analysis, we have used revised data included in the Interim Feasibility Report and Environmental Impact Statement for Oliver Lock Replacement. Construction cost allocated to power was estimated at $21,844,000, and the interest rate applied was 9.5 percent for interest during construction on the construction cost allocated to power and on annual interest expense.

We have examined the revenue potential from the system of Federal hydroelectric projects within the States of Georgia, South Carolina, and Alabama, including all existing projects as well as the Oliver Project. Based upon a completely coordinated power operation of these projects such that they are integrated hydraulically, electrically, and financially, we are assured that we can obtain power revenue sufficient to repay all costs associated with the production and transmission of the power produced by the system including the amortization of the capital investment allocated to power within 50 years from the time that each increment of power investment becomes revenue producing. This, in our opinion, clearly establishes for power the financial integrity of the complete Georgia System including the Oliver Project.

Sincerely,

Curtis H. Bell
Acting Administrator